CONFERENCES - MYCOLOGICAL ...

20/B

Board of Agriculture in India

PROCEEDINGS

OF THE

Second Meeting of Mycological Workers in India

Held at Pusa on the 20th February 1919 and following days

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1919

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No. 867 P. of 1919-20.

FROM

G. A. D. STUART, ESQ., I.C.S.,
Offg. Agricultural Adviser to the Government of India.

To

THE SECRETARY TO THE GOVERNMENT OF INDIA,
DEPARTMENT OF REVENUE AND AGRICULTURE,
SIMLA.

Pusa, Bihar, 13th August 1919.

SIR,

I have the honour to submit the Proceedings of the Second Meeting of Mycological Workers in India, held at Pusa on 20th February, 1919, and following days. These proceedings have been recorded by Dr. F. J. F. Shaw, Second Imperial Mycologist, and Mr. J. F. Dastur, Supernumerary Mycologist, who acted as Secretaries.

I have the honour to be,

SIR,

Your most obedient servant,

G. A. D. STUART,
Offg. Agricultural Adviser to the Government of India.

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SECOND MEETING OF MYCOLOGICAL WORKERS IN INDIA, 1919.

Third Row : C. C. Sen, S. Sundararaman, M. K. Venkata Rao, K. P. Srivastava, Muhammad Taslim, A. Hafiz Khan, S. L. Ajrekar, G. B. Patwardhan, L. S. Subramanium, K. D. Das.

Second Row : G. P. Hector, W. McRae, Captain Froilano de Mello, E. J. Butler, R. D. Anstead, A. C. Tunstall, F. J. F. Shaw.

First Row : K. F. Kheshwalla, J. F. Dastur, G. S. Kulkarni, W. Robertson Brown, S. N. Mitra, P. C. Kar, Muhammad Azmat Ullah Khan.

The Second Meeting of Mycological Workers in India.

INTRODUCTORY.

The Second Meeting of Mycological Workers in India was held at Pusa on the 20th February, 1919, and following days, Dr. E. J. Butler, M.B., F.L.S., being Chairman.

Members.

The members present were :—

1. E. J. Butler, M.B., F.L.S., Imperial Mycologist. (Chairman.)
2. F. J. F. Shaw, D.Sc., A.R.C.S., F.L.S., Second Imperial Mycologist. (Secretary.)
3. J. F. Dastur, M.Sc., First Assistant to the Imperial Mycologist. (Secretary.)
4. Captain Froilano de Mello, Director, Bacteriological Laboratory, Nova Goa.
5. R. D. Anstead, B.A., Deputy Director of Agriculture, Planting Districts, Madras.
6. G. P. Hector, M.A., B.Sc., Economic Botanist, Bengal.
7. W. McRae, M.A., B.Sc., F.L.S., Government Mycologist, Madras.
8. W. Robertson Brown, Agricultural Officer, North-West Frontier Province.
9. A. C. Tunstall, B.Sc., Mycologist, Indian Tea Association.
10. S. L. Ajrekar, B.A., Acting Economic Botanist, Bombay.
11. G. S. Kulkarni, L.Ag., Assistant Mycologist, Bombay.
12. G. B. Patwardhan, B.Sc., Assistant Economic Botanist, Bombay.
13. S. Sundararaman, M.A., Assistant in Mycology, Madras.
14. K. P. Srivastava, Acting Economic Botanist, Central Provinces.
15. A. Hafiz Khan, Assistant to the Forest Botanist, Dehra Dun.
16. M. K. Venkata Rao, M.A., F.R.H.S., F.L.S., Senior Assistant Mycologist, Mysore.

17. S. N. Mitra, Assistant to the Imperial Mycologist.
18. L. S. Subramanium, Assistant to the Imperial Mycologist.
19. K. F. Kheshwalla, B.A., Assistant to the Imperial Mycologist.
20. P. C. Kar, Fieldman, Mycological Section, Pusa.
21. Muhammad Taslim, Fieldman, Mycological Section, Pusa.
22. Muhammad Azmat Ullah Khan, Fieldman, Mycological Section, Pusa.

VISITOR.

2. In addition, Mr. J. Mackenna, C.I.E., M.A., I.C.S., Agricultural Adviser to the Government of India and Director of the Agricultural Research Institute, Pusa, attended on the first day and at the discussion on the formation of an Imperial Bureau of Mycology.

PROGRAMME.

3. The programme before the meeting consisted of the following subjects :—

I.—Provincial disease survey. An account of the work in hand in the different provinces. Suggestions for extending mycological work in the provinces and for popularizing the knowledge of plant diseases amongst cultivators.

II.—Discussion of the proposal to form an Imperial Bureau of Mycology in England, with special reference to the directions in which the Bureau may be made most useful to Colonial and Indian mycologists.

III.—Discussion on spraying and fungicides.

IV.—Discussion on diseases of planters' crops.

V.—Mycological Education in provincial agricultural colleges.

VI.—The application of genetics to the control of plant disease.

A lecture on Medical Mycology by Captain Froilano de Mello, Director of the Bacteriological Laboratory, Nova Goa.

A demonstration of some laboratory methods and a discussion on laboratory technique.

PROCEEDINGS.

FIRST DAY.

Opening of Proceedings.

The Second Meeting of Mycological Workers in India was opened on the 20th February, 1919, by **Mr. J. Mackenna,** C.I.E., M.A., I.C.S., Agricultural Adviser to the Government of India, who **in his introductory speech said** :—

" Dr. Butler and Gentlemen : I desire to extend to you a hearty welcome to Pusa, and to express the hope that your deliberations will be to your mutual benefit and to that of Indian Agriculture.

" Since our last meeting, an event of considerable importance to mycologists has been the publication of Dr. Butler's work on ' Fungi and Disease in Plants.' The book is a credit not only to himself but to Indian mycology of which he is the recognized head.

" Now, gentlemen, I hope you will not be offended if I say that there is no branch of agricultural science which is more of a mystery and is less understood both by the cultivator and by the general public than mycology. The days may be gone when the services of one of your number, under the old appellation of Cryptogamic Botanist, were refused by a Local Government, so tradition has it, on the ground that they already had an Epigraphist. But it is still true that the ordinary cultivator is very much in the dark as to the scope of your operations, and nine-tenths of what are really fungus diseases are attributed by him to the depredations of elusive insects which prefer the darkness rather than the light because their deeds are evil, and which are never seen because they do their fell mischief under cover of night.

" Perhaps a simple description of your duties would be to say that you are the physicians of the plant world. But with what difficulties are you confronted in the exercise of your profession ? The ordinary medical man gets much assistance in his diagnosis from what his patients can tell him of their symptoms and feelings. A patient can, in most cases, answer questions intelligently, while temperature and external symptoms are an aid in determining what is the matter. The veterinary officer also has many of these aids to a correct diagnosis. The animal shows symptoms which, in many cases, are closely allied to those of a human subject. His

owner can assist in the examination by describing the behaviour and conduct of the animal under the illness. In fact, in the ordinary simple villager's mind, human and animal medicine seem to be closely associated : for it is by no means uncommon for a cultivator to bring a relative to a veterinary hospital for medical treatment. As an old Burman, who had brought his wife to the Rangoon Veterinary School, once said to me, ' a veterinary officer must be much cleverer than a doctor, because the veterinary man can tell what is the matter with a dumb animal that cannot speak,' while his old woman could tell the doctor what were her feelings and symptoms. Therefore he preferred to bring his wife to the veterinary instead of to the medical hospital.

" How much greater would be the admiration of my old Burman friend for the physicians of the plant world who have, in most cases, to do their diagnosis unaided or with the most inaccurate information from the owners of the plants. ' The canker which the trunk conceals is revealed by the leaves, the fruit or the flower', and this is about the limit of the data you ordinarily have for diagnosis.

" Your work is beset by enormous difficulties. Diseases frequently remain unreported because while they may be present the effect on the crop may not appreciably affect the outturn on any particular holding. This is especially the case with crops grown in bulk—such as rice, wheat, or oats. It is only when we have a careful observer, or when a whole holding or a whole village is devastated, that any notice is taken of the matter.

" But, in the case of crops grown under more careful supervision, and the more valuable crops, such as coconuts, tea, coffee and rubber, disease is as a rule more obvious, and fortunately is generally reported in the earlier stages. Where an individual plant is under individual treatment, observation is clearly much more easy, and where that individual plant is valuable, its state of health is a matter of serious import : for the disease of one may easily, if not attended to, affect many others.

"What, therefore, seems to be required is a vast army of observers who will bring to the notice of mycologists any trace of what appears to be disease in any of our agricultural crops, so that these diseases may be studied and remedies be ready for application if they assume serious dimensions. To carry on the medical analogy, the mycologist may be regarded as the medical specialist called in as a rule in the most difficult cases. But there must also be a large body of general practitioners able to deal with simpler cases, competent to apply remedies which have been proved by research, and who know when it is necessary to call in a specialist.

" Finally, ' he who cures a disease may be the skilfullest but he that prevents it is the safest physician,' and in the region of mycology, I am glad to say, we have already many cheap and effective preventive measures. I need only refer to the great success which has been achieved in the steeping of *jowar* seed with copper sulphate : to the steps being taken at Pusa for the treatment of jute seed : and to the care being devoted in Bombay to the treatment of potato seed. In plant disease, as in all other diseases, prevention is certainly better than cure."

On the conclusion of Mr. Mackenna's speech, **Dr. E. J. Butler,** Imperial Mycologist, **addressed the meeting as follows** :—

" Mr. Mackenna and Gentlemen : When we last met, at the First Mycological Conference two years ago, we were testing experimentally, in the manner of scientists, the methods most likely to lead to a solution of the problem before us, which was whether we could profitably bring together those interested in mycology in India to discuss their work at periodical intervals, and so to reduce, as far as possible, the comparative isolation of the few mycologists scattered throughout India at great distances from one another.

" We submitted our proceedings to Government, as did our colleagues in entomology, and as a result a proposal to hold sectional meetings of the Board of Agriculture in years in which a meeting of the full Board is not held was referred to the tenth meeting of the Board at Poona, in December, 1917, and considered by a Committee.

" The terms of reference were :—

To consider whether it would be an advantage to workers in particular branches of agricultural science to meet more frequently than at the biennial meetings of the Board of Agriculture and, if so, to formulate a scheme for holding such sectional or special meetings in years in which a full meeting of the Board does not take place.

" The Committee reported as follows :—

On the general question of holding sectional meetings the committee consider that there are many subjects of a technical character which can be better discussed at leisure at a meeting of officers who have specialized in the particular branch of work than debated at the Board of Agriculture. They rather look forward to a time when the Board, or possibly the Government of India, will refer matters of a purely technical character to such sectional meetings. As an illustration of the subjects they have in mind, a reference may be made to the question of checking the accuracy of certain analytical methods at present employed referred to in one of the reports. They would not, however, at this stage propose that these meetings should be formal in character or that any definite programme should be laid down. The first essential is that men engaged in the same branch of work should meet one another at fairly frequent intervals and exchange ideas.

The proceedings should be informal, and the results—unless of course a special reference of the nature indicated above is made—not necessarily published. If papers are read and a discussion follows, it will probably be decided to publish the proceedings. The

committee are not impressed with the danger of a lack of co-ordination in view of the very small number of workers and the field to be covered—indeed a certain duplication of experimental work is not to be deprecated. But they do consider that research work is not best carried on in comparative isolation and that the workers would be the better for an occasional meeting and interchange of views.

Successful meetings of the mycological and entomological sections having already been held, the committee did not consider it necessary to discuss the desirability of holding similar meetings in future. As regards the interval at which such meetings should be held, they were of the opinion that they should be held in years when the Board of Agriculture did not meet, that is, every two years. As the collections are larger at Pusa than elsewhere, it would probably be preferable to arrange for the meetings at that centre. They should not necessarily be confined to members of the Agricultural Department, but others interested in the subjects be invited to attend. The committee consider it probable that if Deputy Directors were informed beforehand that subjects of particular interest to them, such as the diseases or pests of crops on which they are working, would come under discussion, some at any rate would like to be present. It was suggested therefore that the officer in charge of the section at Pusa should notify so far as possible in advance the subjects it was proposed to deal with.

" The rest of the Committee's report, dealing with meetings of other sections, does not directly concern us.

" The Board finally passed the following resolution :—

That meetings of the mycological, entomological, and chemical sections be held in years in which there is no meeting of the Board of Agriculture, and that these should not be confined to members of the Agricultural Department but others interested in these subjects be invited to attend. That agricultural officers engaged in experimental work should also hold periodical sectional meetings to discuss their results and methods.

" This resolution has been accepted by the Government of India, and we are therefore meeting under a somewhat more definite constitution than on the last occasion.

" We are still in the experimental stage. I personally believe these meetings are of the greatest utility to all of us, serving as they do to bring us together and stimulate our interest in the work of each member. We all desire to make them as attractive to the majority of the members as possible, and any suggestions to this end will be most welcome. One of our main functions should be, I think, to focus attention on the more important mycological problems in India, and I suggest that in our consideration of Subject I—the survey of the mycological work which is in hand at present and suggestions for extending it—we should concentrate, as far as possible, on the major crop diseases.

" In this connection I should like to call attention to the work of the War Emergency Board of American Plant Pathologists. This body was formed a little over a year ago with the object of stimulating and accelerating phytopathological work in America to the end that, in this present world crisis, the reduction of crop losses from diseases should be made most effective as a factor in the increase of our food supply.

" Of the extent of these losses, the following figures compiled by the Board, for the United States alone, in 1917, give some indication :—

	Bushels
Wheat	64,440,000
Rye	2,685,000
Barley	12,252,000
Oats	153,973,000
Maize	175,344,000
TOTAL FOR CEREALS	408,694,000
Potatoes	117,174,000
Beans	2,528,000
Sweet Potato	41,707,000

" And this was in a year which was not an especially bad one so far as diseases were concerned. Furthermore, the estimates were most carefully framed and are stated to be the most reliable that have ever been made. Had oat smut been completely controlled (and we know that it can be, to all intents and purposes) the amount of this cereal exported to the Allies and neutral nations during 1917 could have been almost doubled, while twice as much maize was lost from smut as was exported.

" With your permission I shall read a letter which I received a short time ago from the Chairman of the War Emergency Board of American Plant Pathologists :—

I am taking the liberty of calling to your attention the work of the War Emergency Board of American Plant Pathologists. Under separate cover you will receive a copy of the mid-year report of the Board and a copy of the report of one of our project meetings, " Diseases of Potatoes and Seed Certification."

The aims of the Board and the general character of the work under way is briefly set forth in the mid-year report. In short the object of this Board, elected by the American Phytopathological Society, in January 1918, is :—

(*a*) to arouse our membership to their full responsibilities and opportunities in the present food crisis of the world ;

(*b*) to effect among the workers in our field co-ordinated co-operation in the solution of disease control problems of emergency importance ;

(*c*) the widest adoption among our growers of well established and practical methods of disease control, such as cereal seed treatment, spraying, dusting, seed treatment of potato seed tubers, etc., and

(*d*) a campaign to educate the general public, especially the consumers, on the economic importance to them of the diseases of staple crops and the control of the same.

The result of the Board's efforts have been far beyond our expectations. Our colleagues have exhibited a spirit of co-operation and self-elimination unprecedented among American scientific men. We are working unitedly and enthusiastically under a system of democratic centralization of leadership which promises great results for our part in the nation's war programme.

We are anxious to know what our colleagues in the allied countries are doing along similar lines. We want your assistance and suggestions. We are prepared to place at your command every new fact, every idea, and every resource at our disposal that may be of service to you in meeting the plant disease problems which confront you. We know you will reciprocate in kind.

If you know of any phytopathological organization or agency in your country functioning in a manner similar to our War Emergency Board, we shall appreciate being put in touch with it.

We are planning for our annual meeting in Baltimore, Md., December 27 to January 1 next, a series of " project conferences " on the most pressing disease problems affecting our staple crops. On behalf of the American Phytopathological Society, I extend to you personally and through you to representatives of phytopathological organizations in your land, a most cordial and urgent invitation to meet with us. I feel sure that representatives from our profession in allied countries could bring us much of distinct interest and value in the present emergency. I shall send you a copy of the programme of this meeting shortly.

I enclose a list of those in your country to whom copies of the reports are being sent. I shall be glad to send them to others who may desire them so far as they are available.

If you feel that our Board can be of service in any way to the pathologists of your country, we shall welcome the opportunity to serve.

" To this I replied that I would bring the Board's generous offer of assistance before our meeting, and I beg to propose that the following resolution be passed and that a copy of our proceedings be sent to the Chairman :—

Resolution I.

" That the Second Meeting of Mycological Workers in India desires to express its gratitude for the generous offer of assistance in phytopathological matters which has been received from the War Emergency Board of American Plant Pathologists. This meeting welcomes the opportunity of co-operating in mycological work with the scientists of an allied nation, and will do everything in its power to reciprocate in the exchange of information for the general furtherance of the objects of the War Emergency Board."

This resolution was seconded by Dr. Shaw and carried unanimously. The Chairman then continued :—

" Now we know that the losses caused in this country by plant diseases are in many cases equal to those recorded elsewhere. It is true that our chief cereal—rice—is relatively less attacked by parasitic fungi, in India at least, than most other grain crops, but the aggregate damage is probably considerable. Mr. McRae has just described a serious outbreak of blast in Madras, and the sclerotial diseases that Dr. Shaw has studied perhaps do far more damage than is realized on a cursory examination. Rust of wheat is at least equally severe in this country as anywhere in the world, and the annual losses from it are enormous. It is, however, when we turn to the smuts that we find perhaps the greatest aggregate reduction, from disease of an easily preventable type, in the food supply of India. Mr. Kulkarni has calculated the loss from the smuts of *jowar* (*Andropogon Sorghum*) to be over a million sterling annually in Bombay Presidency alone. From his work it is evident that an addition of 10 per cent. to the yield of this important food grain in Western India is quite feasible by the control of this disease.

" It is on problems such as these that it seems to me we might concentrate our attention during the present world shortage of food

supplies, and when discussing Subject I we shall, no doubt, be able to bring out this aspect of our work more forcibly.

" To assist in our consideration of Subject II—the proposed Imperial Bureau of Mycology—I have prepared a note which is being circulated. I need not therefore further refer to this subject.

" Subject III—spraying—is one on which we should be able to have an interesting discussion, since I believe that practically all those who have taken an active part in spraying against fungus diseases in India are present.

" In Subject IV—the diseases of planters' crops—we have the advantage of the presence of Mr. Tunstall, Mycologist to the Indian Tea Association, and Messrs. McRae and Anstead who are familiar with the mycological problems of South Indian planters' crops. Mr. Dastur will be able to tell us of the special troubles of the Burma rubber planters, so that almost all the important planting areas are represented. My recent visit to the immense rubber planting districts of Malaya has brought home to me, in a particularly vivid fashion, the importance of the disease problem in what should be regarded as a great Imperial asset, and convinced me that we cannot give too great attention to the constantly increasing menace of disease in these planting industries.

" Subject V—mycological education—is one in which most of the provincial representatives are directly interested. It appeared that an interchange of views based on actual experience might be of value, now that mycological teaching has become more or less established in the different colleges. Some of our members have been good enough to bring with them models and diagrams in use in their colleges, and I hope that we shall have a very interesting discussion.

" With regard to Subject VI—the control of plant diseases by the methods of the plant breeder—it has been included rather to call attention to the exceedingly valuable work which is being done in a few countries in this direction than to make definite proposals. It is probable that we are not in a position to start work of this kind immediately, but it may be useful to get some idea of the possibilities of this method, so as to examine before our next meeting what cases exist in India on which it might be worth while to test the breeding of resistant varieties.

" This meeting is memorable as being the first in which we welcome a visitor from another country. In Captain de Mello we greet not only the distinguished scientist, but the representative of our most ancient ally, Portugal. I am sure that all will join with me in thanking him for coming from Goa, to attend our meetings and to tell us something of the results of his studies in the subject

of medical mycology in which he is the leading authority, indeed almost the only worker, in the Indian continent.

"With Mr. Mackenna I join in welcoming all those who have come, some from great distances and at considerable inconvenience, to assist in making this meeting the success that I hope it will be, and I would ask you to join with me in turn in thanking Mr. Mackenna for his great kindness in coming here to-day to open our proceedings, and for the interest he has shown in all the arrangements for the meeting."

The meeting then proceeded to consider the first subject on the programme.

SUBJECT I.—PROVINCIAL DISEASE SURVEY. AN ACCOUNT OF THE WORK IN HAND IN THE DIFFERENT PROVINCES. SUGGESTIONS FOR EXTENDING MYCOLOGICAL WORK IN THE PROVINCES AND FOR POPULARIZING THE KNOWLEDGE OF PLANT DISEASES AMONGST CULTIVATORS.

The Chairman said that in view of the present economic crisis in the world's food supply, the meeting should give special attention to diseases of food crops and the means of combating their ravages. He then asked Mr. Ajrekar to tell the meeting what he knew of storage rot of **potatoes.**

Mr. Ajrekar informed the meeting that several fungi were found causing disease in stored potatoes. *Rhizoctonia Solani* and *Rhizoctonia destruens* and some *Fusaria*, particularly *Fusarium trichothecioides*, caused dry rots. A wet rot was also found under storage conditions. It began with *Rhizoctonia* and sometimes with *Fusarium*, but the specific cause of the wet rot was not definitely known. It might possibly be due to bacteria. Dr. Mann had described a black rot of potatoes associated with *Rhizoctonia Solani*, but it appeared to be induced by some physical cause such as high temperature.

Mr. Kulkarni gave an account of Dr. Mann's work in connection with potato storing carried out in co-operation with a private firm called the Union Agency at Poona. In Bombay the largest potato growing district was Poona where nine-tenths of the crop was grown. Before the war, Bombay's chief supply of potatoes came from Italy, but now that this source was cut off, Bombay had to supply its own needs. Therefore the Director of Agriculture had sanctioned Rs. 10,000 for potato storing experiments. But, before this work could be taken in hand, there was a large demand for the army in Mesopotamia, and the Union Agency Potato Works were established to meet this demand. This gave an excellent opportunity to

investigate the storage rots of potato. In two years 900 tons of potatoes were sent to Mesopotamia. Potatoes from all parts of India were brought to Poona where they were fumigated with petrol vapour against potato moth. The potatoes were sorted twice by coolies, and a third sorting was done by Dr. Mann and his staff before they were put into bags ready for export.

Dr. Shaw said that the arrangements for packing and fumigating the potatoes at the Union Agency appeared to be very efficient. The fumigating chamber was a well, covered with an iron lid, with the joint made tight by a water gutter. The difficulty of obtaining an air-tight chamber was thus solved in a very practical manner; after fumigation, the potatoes were sorted. The sorting was carried out on long, low, sloping benches. A coolie emptied a sack on the upper end of the bench, and the sorters, who were seated on either side of the bench, rolled the potatoes along and picked out all diseased and unsound potatoes. Thus, only healthy potatoes reached the lower end of the bench, where they fell into a basket and were then removed for packing. The packing was done in 60 lb. lots, loose in a sack, the sack being enclosed in an open crate.

Mr. Kulkarni said that in an ordinary room about 100 to 200 bags were generally stored, and in hot days about 50 per cent. of stored potatoes were spoilt by black rot. Black rot was attributed to bacteria by the Imperial Agricultural Bacteriologist, but, besides bacteria, *Rhizoctonia Solani* also was found in potatoes suffering from this disease. In order to see if high temperature was really the cause of black rot, some potatoes were stored in incubators at high temperature, and after 4 days these potatoes showed characteristic blackening. Bacteria and *Rhizoctonia* also occurred in such potatoes.

Dr. Shaw inquired if the blackening was obtained in the absence of fungi and bacteria as the result of high temperature.

Mr. Kulkarni replied in the negative, and said that further experiments were under progress.

The Chairman remarked that, from the stories of interned prisoners that reached England, the potato shortage in Germany during the first year of the war was the biggest experienced during the whole period, because, under the military control system, practically the whole potato crop was collected in several centres and stored in piles 30 or 40 feet high. The result was that, on account of the high temperature developed in the heaps, the potatoes sweated and broke down in a wet mass.

Mr. McRae pointed out that even good potatoes went bad when sent by rail; some means must be devised so that they might reach the consumer safely.

Mr. Tunstall suggested the use of returnable crates instead of bags. Such crates would be cheap and the inside temperature would be greatly reduced.

Mr. McRae was of opinion that they would be very expensive and difficult to get.

The Chairman doubted if anything cheaper and more suitable than the Union Agency's method could be devised.

Mr. Ajrekar informed the meeting that scab disease of potatoes caused by *Spongospora subterranea* was not only found in Mahabaleshwar (Bombay Presidency) but was also found on potatoes grown in the north Indian hills and on the Nilgiris. About 10 per cent. of the potatoes received from the hills were found to be scabbed. This disease has not so far been observed on potatoes grown on the plains, probably because the causal organism does not thrive in the high temperature of the plains.

The Chairman inquired if any treatment was tried, after harvesting, to prevent storage rot. Much work was done in America in the way of treating seed potatoes. Various methods were suggested by the War Emergency Board, *e.g.*, dipping in solutions of copper sulphate, formalin or corrosive sublimate. As far as he knew very little work in India was done in this direction.

Mr. Ajrekar said that he had tried the corrosive sublimate treatment against *Rhizoctonia* but was not successful.

The Chairman remarked that while the Italian market was cut off, the Bombay Presidency would be in want of good seed, and so the Bombay Department should take up the seed treatment in co-operation with the Union Agency.

Mr. Anstead said that ring disease of potatoes was very common in South India, but the disease could not be checked merely by rotation and by not growing solanaceous crops on potato fields. The systematic removal of all solanaceous weeds was essential. He was emphatically of opinion that no successful results could be obtained if solanaceous weeds were not removed.

The Chairman remarked that Dr. Mann's results in connection with the ring disease were opposed to American experience, where it was found that the bacillus in the form which caused tobacco wilt lived in the soil for 5 or 6 years.

Mr. Anstead pointed out that Dr. Mann's experiments were done in pots, clean weeded, and these pots were liable to be left dry after the end of the season, and so, from these experiments, conclusions could not be drawn as to what happened under field conditions.

Mr. Kulkarni said that Italian seed tubers were resistant to ring disease but tubers raised in India from these imported seeds were not resistant.

The Chairman remarked that perhaps the resistance broke down after some years if Italian tubers were grown in India.

Mr. Kulkarni said that if tubers from wilted plants, showing no signs of the ring disease, were planted they gave a diseased crop. Therefore it was necessary to remove all wilted plants. Affected tubers could be recognized by having black, dead eyes. Infection from diseased seed to healthy was carried through the knife at the time of cutting the setts. This infection was avoided by dipping the knife in a pot of boiling water immediately after it had cut a ringed potato. The cultivator could afford to remove wilted plants because he could recover the loss from healthy seed which fetched a high price.

The Chairman suggested that the Union Agency being the biggest potato storing and supplying firm should start a nursery of its own to raise disease-free seed.

Mr. Sundararaman gave an account of the conditions in Madras. For the use of the army, potatoes from the Nilgiris were collected, selected and packed in Wellington, and sent to Madras to be stored in large godowns from which they could be distributed to the different military stations in the Presidency. It was soon found that half of the potatoes sent from Madras reached their destination in a rotten condition. The godowns in Madras were inspected and 40 per cent. of the potatoes were found to be affected by wet rot. The tubers were again selected and bagged but became badly rotted during their journey to the military centres. In Madras the temperature, at the time of storage, ranged between 90° and 95°, and the rot was due to this high temperature. Mr. McRae advised that the potatoes should not be stored in Madras but should be stored in cool and well ventilated godowns in Wellington. The military authorities accepted this advice and the results were satisfactory.

Mr. McRae said that the major part of the potatoes in the Nilgiris were attacked by ring blight. There were two ways of tackling this disease—

(1) rotation and
(2) opening new areas.

No rotation was practised in the Nilgiris because there was no suitable crop to replace potatoes. Barley and oats were suggested as substitutes but there was no market for these cereals.

Mr. Venkata Rao, in this connexion, said that there had been a similar difficulty in practising rotation in Mysore. On account of

the ring blight continuous potato growing had become unprofitable, and so the cultivators had introduced a rotation with bush mulberry. Experiments in rotation with a view to freeing the soil from *Bacillus solanacearum* were carried out. There were 3 series—

(1) potato followed by potato :

(2) potato followed by *jowar*, and in the next season again potato :

(3) potato followed by *jowar* for 3 years, and in the fourth year potato. In this last series, the potatoes remained practically disease-free. This season potatoes from Simla supplied by the Punjab Department were being tried. So far ($2\frac{1}{2}$ months) they were free from disease.

Mr. McRae said that he was in search of a suitable rotation for potatoes but had so far failed, and so mulberry was a very important suggestion. He did not know whether mulberry in the Nilgiris would be a possible alternative. At present it was not grown there as an economic crop.

Lord Pentland's seed farm at Nanjanad had been recently opened. This farm was of 100 acres of which 35 acres were actually under plantation. Numbers of Scotch varieties were being tried. At first the agriculture of the crop under the conditions found in the Nilgiris was being studied, but it was proposed to take up experiments on ring disease as soon as the best methods of cultivation had been ascertained. Imported seed, free from the blight, was given to the ryot, but it gave a diseased crop because the infection was already in the soil. It was difficult to find a field which was free from infection, because the depredations of pigs and porcupines necessitated the protection of cultivation by semi-permanent enclosures, and this led to long-continued growth of potatoes in the same area.

Scab was very common in the Nilgiris. In the Government Garden, seed was treated with mercuric chloride, and this treatment made a big difference in the intensity of the attack. He had not seen eelworm disease in the Nilgiris, but Mr. Ajrekar had found this disease on seed obtained from the Nilgiris, specimens of which had been sent to Pusa.

The Chairman said that this disease had been first brought to Pusa by the Imperial Entomologist. The eelworm concerned was *Heterodera radicicola*.

The diseases of **cereals** were next discussed.

Mr. Ajrekar said that, in Bombay, the most important diseases of *jowar* were the different smuts, work on which had been published

by Mr. Kulkarni.[1] Popularizing the treatment of seed by steeping in copper sulphate was carried out on the same lines as in previous years, and there was a steady annual sale of 40,000 to 50,000 of the 1-anna packets.

Mr. Srivastava said that, in the Central Provinces, the use of copper sulphate as a preventive against smut was demonstrated in district agricultural exhibitions and shows. Copper sulphate was sold in small packets.

The Chairman suggested that some of the ryots' own seed should be treated, so that they could see for themselves the advantages of seed treatment. In the Central Provinces, the department bought copper sulphate and made up small packets with instructions in Hindi and Marathi.

Mr. Srivastava was of opinion that the propaganda work against smuts could be more actively pushed by the agricultural assistants, but they were so much overworked with purely agricultural demonstrations that this sort of anti-disease propaganda was to them of only secondary importance. In 1910 and 1911 packets of copper sulphate were sold by the agricultural assistants, but now demonstrations were found to be sufficient.

The Chairman remarked that no progress could be made in provinces where there was no mycological staff.

Mr. Kulkarni also was of opinion that disease propaganda work in provinces where there was no adequate mycological staff was bound to suffer as the district staff had multifarious duties.

The Chairman expressed disappointment that there was not a greater increase in the sale of the 1-anna copper sulphate packets in Bombay.

Mr. Kulkarni pointed out that the sale of these packets could not be considered an index to the popularity of the treatment, because now the cultivators bought their own copper sulphate direct and treated their own seed. Both in Bombay and the Central Provinces the co-operative societies took much interest in distributing copper sulphate packets.

Mr. McRae said that, in Madras, the district staff did this work. The Deputy Director deputed junior assistants to push the copper sulphate treatment. A few acres in a village were taken and the grain was treated and sown. Thus, one demonstration was given to a whole village, and therefore a far larger amount of grain was treated by the people themselves than by the district staff, which was very limited. In 1917 and in 1918, 9,000 and 10,000 acres,

[1] Kulkarni, G. S. "Smuts of Jowar (*Sorghum*) in the Bombay Presidency." *Pusa Agric. Res. Inst. Bull. No. 78.*

respectively, were treated by the staff. Smut of Cumbu (*Pennisetum typhoideum*) was treated with copper sulphate without any apparent effect on the smut of this crop. He was hopeful that as more men from agricultural colleges were turned out more work in smut-prevention would be done.

Mr. Kulkarni observed that the district agricultural officers went out into the countryside to spread the gospel of agricultural improvement " bearing the iron plough in one hand and a packet of copper sulphate in the other." Seed treatment in *jowar* was a normal agricultural operation in the Presidency of Bombay. With regard to the extent of loss in a smutted field the percentage varied between 17, in the case of bad attacks, and 3, in the case of mild attacks. A fair average would be about 10 per cent.

The Chairman said that in the sub-montane parts of the United Provinces and also in some parts of the Punjab smut of *jowar* was common.

Mr. Robertson Brown said that he had not seen it in the North-West Frontier Province.

Mr. Ajrekar said that the sugary disease of *jowar* was common in Bombay. A *Cerebella* was associated with the *Sphacelia* which caused the disease, and he had formerly considered it to be the ergot stage. Dr. Butler had suggested to him that it might be an epiphyte, and personally he was now inclined to consider it as such, having failed to trace any connection between the two forms. Further study on this disease could not be done last year as no material was available, because of the unusually dry monsoon. Chemical analysis of the *Cerebella* had given no reaction for ergot. One rabbit, out of four fed with *Cerebella* bodies, died of colic in 24 hours. This experiment was repeated but no ergotic effects were developed, and the death in the one case in the previous experiment might be due to some other cause. *Jowar* heads with *Cerebella* on them were fed to the cattle by the cultivators without any ill effects.

The Chairman inquired of the Bombay representatives if they had had any report of a very serious disease of *jowar* in Sind. The Commissioner of Sind had reported that a disease known locally as *jowari khas* had caused great loss last season. It was said to be associated with a small fly. The cause was unknown, but the Chairman suggested that it might be the bacterial disease of sorghum prevalent in the United States.

Mr. Ajrekar stated that he did not know of this disease, but that Mr. Main, Deputy Director of Agriculture for Sind, had informed him that the *jowar* crop was only about one-fifth of the normal yield. Other cereals were also affected.

The Chairman said that next year attention should be given to this apparently obscure disease. The Commissioner had reported that it was a most serious matter both to the ryots and to Government which had to grant considerable remissions of land revenue on its account.

The Chairman, in opening the discussion on wheat diseases, remarked that bunt was exceedingly prevalent in Kashmir but was not known in other parts of India except in some areas in the Punjab and in Baluchistan. It was usually just as easy to prevent as *jowar* smut, but so far as he knew nothing had been done to check it.

Mr. Robertson Brown remarked that the chief wheat smut in the North-West Frontier Province was the loose smut. Federation wheat was resistant, but Pusa 4 was very commonly smutted. Pusa 12 was attacked to a less extent than Pusa 4. Local wheat was usually not much smutted, but in certain years it was as bad as Pusa 4. Cawnpore 13 was also affected but not as much as Pusa 4. As a rule, bearded wheats were more susceptible.

The Chairman remarked that in Pusa there was little or no loose smut because at the time of flowering there was rarely any rain.

Dr. Shaw remarked that loose smut of wheat occurred to a certain extent in the vicinity of Mandalay.

Mr. Srivastava was of opinion that this disease was increasing in Central Provinces, and that bearded varieties on the Nagpur Farm were more infected than unbearded. He found Pusa 4 very susceptible because of the open character of the glumes.

In reply to the Chairman's inquiry, Mr. Robertson Brown said that it was advisable to go on with variety tests. Several varieties were being tested on his farm; though there was always possibility of infection yet Federation remained free from smut. This suggested that wheats with open glumes were more susceptible than wheats with closed glumes.

Dr. Shaw remarked that the use of the hot water treatment could not be advised to cultivators because it was difficult for them to carry out, but Mr. Robertson Brown might perhaps try it for his own seed on the Tarnab Farm.

The Chairman pointed out that formalin was absolutely successful against smut of oats, which was a common disease in Bihar, and that seed treatment was now a routine matter in many indigo factories which grew oats. In order to have an object lesson in the extraordinary variation in susceptibility of different varieties of wheat to the rust *Puccinia triticina*, he invited the members to go round the Pusa Farm where several varieties of wheat were being

tried. Pusa 4 and Federation and a few other varieties were resistant, but some of the Sind and Jubbulpore wheats were badly infected. It remained to be seen whether Federation would be immune to the attacks of the later rusts in Pusa, *P. graminis* and *P. glumarum*.

Mr. Robertson Brown said that Federation was a slow ripening wheat and might possibly be attacked by *P. graminis*.

The Chairman said that growing resistant varieties was the only way of combating rust. Khapli in the United States of America was a pedigreed strain and was one of their most resistant varieties, but, in India, Khapli was a mixed variety and therefore not reliable.

Mr. Srivastava remarked that in the Central Provinces Khapli was resistant.

The Chairman referred to the rust-resisting properties of some South Russian wheats the cultivation of which, or of hybrids from them, appeared to be extending in the United States chiefly because of this character. He did not know if they had been tried in India.

Mr. Robertson Brown said that he had observed that the better growing wheats seemed to get rust worst.

Mr. Ajrekar inquired whether Biffen's wheats were successful.

The Chairman said that the Fen and other eastern districts of England were now growing Cambridge wheats extensively. He thought that the rust problem must be solved for each large locality separately. Resistance of wheat to rust varied in different areas, but this might be due to different races of the parasites being restricted to definite localities, so that if a wheat were transplanted to another area it might have to face a different variety of the fungus.

Mr. Robertson Brown, in support of this point, said that Pusa 4 was rusted in Pusa but not in Peshawar. He stated that mildew on wheat was found in the North-West Frontier Province, and even Federation was infected ; he inquired if mildew was found elsewhere as well.

The Chairman remarked that it was very rare, though he had seen it in the sub-montane tracts.

Mr. Ajrekar said that the green smut of rice (*Ustilaginoidea*) was becoming troublesome in the Konkan (Bombay Presidency). It was especially bad when the crop was very good, but in a short crop year there was very little. He had failed to inoculate living plants or to find the mode of infection.

The Chairman remarked that he had also failed to find the mode of infection, but that only meant that it was a question of patience and thinking out all possible ways of infection. He cited the ex-

ample of sugarcane smut in which for many years no one had discovered the exact place of infection, but Mr. Dastur obtained positive results last year. Mr. Dastur had found that the infection could only take place through the scale hairs of young " eyes."

Mr. McRae said that the chief fungal trouble of paddy in Madras was blast, caused by *Piricularia Oryzæ*. This disease was sometimes very severe. This year however not a single case was found, even in those villages where last year rice was badly blasted. This year the harvest had been very late on account of the shortage of rain, and perhaps this might account for the absence of blast.

The Chairman agreed that the incidence might depend on climatic conditions, and remarked that blast must be looked for in the Konkan (Bombay Presidency).

Mr. Kulkarni replied that it was not known in that area but *Ephelis Oryzæ* was occasionally found there.

Mr. McRae observed that this year there was an epidemic of blast on *Panicum repens*, a grass common on paddy *bunds*, though, as already said, paddy was absolutely free. There was unfortunately no record of its occurrence on *Panicum repens* last year, when it was bad on paddy. The disease was worst on highly manured fields, and was therefore a limiting factor on the yield of paddy. It only came on when the yield was very high. It was not known if the form on *Panicum repens* could cross-inoculate on to paddy.

Dr. Shaw observed that *Sclerotium Oryzæ* sometimes did a certain amount of damage in the Central Provinces.

Mr. Srivastava remarked that this disease was more serious in 1917 than last year.

Mr. McRae said that in Madras a fair number of plants were infected by the last named fungus. Mr. Sundararaman had cultivated *Ephelis Oryzæ* in nutrient media for about three years, but had not been able as yet to infect seeds or flowers.

Mr Ajrekar said that, with regard to diseases of maize, out of 30 maize plants raised from seeds got from America, 20 were infected with *Sclerospora* which he thought was the same as that studied by Dr. Butler in Pusa, *viz.*, *Sclerospora Maydis*. He suggested that this disease must have been carried through the seeds.

The Chairman observed that *Sclerospora Maydis* was not known in America. It was reported from Java and possibly occurred in the Philippines. He remarked that the fact that the plants from American seed were affected by *Sclerospora* should be reported to the War Emergency Board. It was not at present serious in India but there had been a few bad attacks, and the appearance of the disease in Bombay was important.

Mr. Sundararaman said that smut on the millet *Setaria italica* could be checked by treating the seed for 30 minutes with 0·5 per cent. of copper sulphate without affecting seed germination; even a 10 per cent. solution did not depress germination. The treatment was not successful if it was done for 15 minutes. He succeeded in obtaining 167 infections out of 300 plants inoculated with the fungus.

Mr. Kulkarni said that he had found a new smut on *Eleusine coracana* and was keeping it under observation.

The Chairman remarked that he thought they had this smut in Pusa on an allied grass. He then asked Mr. McRae to open the discussion on **sugarcane** diseases.

Mr. McRae said that by practising seed selection, stool by stool, he had brought down red rot of sugarcane on the Coimbatore Farm to 1 per cent. As labour was not always available, stool by stool selection was not always possible. He thought that if once such a thorough selection was done, sett by sett selection would be quite enough for some years to come to keep down red rot.

The Chairman said that on the Pusa Farm selection, sett by sett, was practised. From 1904 to date there had been no epidemic as the setts were always examined before planting, but they had not succeeded in bringing down the percentage of infection below 5 to 10 per cent. It seemed that stool selection once in a while followed by sett selection annually was better.

Mr. McRae remarked that there was no red rot on Dr. Barber's Farm.

The Chairman observed that some of Dr. Barber's varieties ought to be very resistant.

Mr. Robertson Brown said that there was very little red rot in Peshawar.

Mr. Kulkarni said that it was commonly supposed that fresh infections occurred from fallen diseased leaves and stems, but he had found that infection from the standing cane was also possible. Eyes and nodes of canes 6 to 9 months old had been found covered with *Colletotrichum* spores. The disease was worst when the weather in October was dry and hot, and when the cane was about nine months old. It was advisable to crush the cane soon after dry winds had commenced blowing, even if it was not mature, otherwise there would be no chance of getting any juice. Varieties which ripened in 9 to 10 months' time after planting were to be preferred as they would be mature before the dry winds set in.

The Chairman inquired how information of the method of combating red rot by sett selection was disseminated to the cultivators.

Mr. Kulkarni replied that demonstrations were given on the Government farms. He referred to the value of introducing new varieties of cane into localities where the varieties cultivated were severely attacked by red rot. It was recognized that this is one of the chief means of lessening the damage caused by the disease.

Mr. Srivastava observed that in the Central Provinces the Khari variety was resistant to smut.

The Chairman expressed his surprise because Khari was known to be most susceptible to smut elsewhere.

Mr. Ajrekar said that thin varieties were attacked most but now thicker varieties were beginning to get infected.

Mr. Srivastava said that he had seen only secondary shoots get smutted and not the primary, and so he thought cultivators should be advised to remove only these secondary smutted shoots and not the whole plant.

Mr. Robertson Brown said that the variety of sugarcane J.33 was badly smutted in Peshawar.

The Chairman said that in Bihar this cane was also badly smutted.

Mr. Dastur gave a short account of his work on smut infection. He said that he had succeeded in getting smutted shoots by inoculating young eye buds. It was not essential to wound the eyes, but it was essential to select very tender eyes. Infections had not succeeded when the scales had turned brown. A smutted shoot was generally produced in two or three months.

Dr. Shaw said that he had found two sclerotial diseases of minor importance at Sindewahi in Central Provinces. They appear to be identical with the Java diseases called Het Zuur Rot and Het Rood Rot.

The Chairman observed that the ordinary field **pulses** were not much affected by disease except perhaps *Dolichos*. *Cercospora* did not do much damage in Pusa, though a certain amount of it was to be found.

Mr. Robertson Brown said that gram wilt was very bad in the Bannu District of the North-West Frontier Province. The tract was very arid and sandy.

Mr. Ajrekar said that gram and pigeon pea wilts were doing some damage in Bombay.

The Chairman remarked that it had been found in Pusa that the incidence of the pigeon pea wilt caused by *Fusarium udum* varied with the amount of manure in the soil. In one case 2,000 wilted plants were collected from a one-quarter acre plot which had been manured, but only 20 were wilted on a one-quarter acre

unmanured, control plot. If one *Fusarium* behaved in this way another might also do the same. Soil conditions might have an effect on a fungus just as it had on a crop. *Fusarium* wilts in the United States of America were found to be much more severe on light sandy soils than on clay soils. This agreed with what Mr. Robertson Brown had reported as to the incidence of gram wilt.

Dr. Shaw gave an account of the sclerotial disease of Rangoon beans (*Phaseolus lunatus*) to investigate which he had recently visited Burma. Last year, alarming reports had appeared in the Burma papers that Rangoon beans were badly blighted by *Phytophthora Phaseoli*. Specimens received from Burma showed this to be a false diagnosis. On account of the rise of prices of these beans their cultivation suddenly increased and ryots began to grow them extensively even in mango gardens. In such gardens the disease was very bad, especially on the north side of the trees where there was a preponderance of shade. The seeds were sown either broadcast or in lines. In the former case the plants formed a thick mat of vegetation on the ground, while in the latter case they were more or less widely separated. Where there was free circulation of light and air the disease was less. The Burma Department of Agriculture had, two years back, published a leaflet advising the cultivators to grow beans in lines. If they had followed this advice, the disease would probably have been much less severe. He thought this was the best way of checking the attack.

Mr. McRae said that no damage was done by *Cercospora personata* to the **groundnut** crop in Madras where it ripened before " tikka " disease came on.

Mr. Ajrekar said that this was true of Bombay.

The Chairman said that in Ranchi this was an unsuccessful crop. Every year it got badly diseased. There were two *Cercosporas* found on it. One was *C. personata*—the cause of true "tikka " disease—and the other was an unnamed species. In Ranchi both *Cercosporas* attacked the stem and killed the whole plant. Attempts to check the attack by soil treatment and the introduction of new varieties had failed.

Mr. Robertson Brown said that, in Peshawar, 4 acres were sown with seeds obtained from Bombay, and the whole crop died of disease. The plants wilted and the leaves turned brown.

The Chairman then asked Mr. Dastur to open the discussion on diseases of **chilli.**

Mr. Dastur said that the chief cause of trouble in Bihar was *Vermicularia Capsici*. It attacked both fruits and stems. From the preliminary experiments it was found that spraying with Bur-

gundy mixture controlled the disease. In 1917, the result of the picking, up to the first week of December, was that from the two control plots the yield of infected fruits was 28 and 33 per cent., and from the sprayed plot it was 7 per cent. The experiments were repeated last year, but no results could be obtained on account of the unusually dry conditions which completely checked this disease.

Mr. McRae said that in Madras *Vermicularia* was causing considerable loss of fruits, and that spraying had not given as good results as had been obtained by Mr. Dastur. He had only succeeded in reducing the loss from 35 to 17 per cent.

Mr. Dastur pointed out that this was possibly due to the different climatic conditions of the two tracts. In Bihar the disease was checked as soon as winter set in, and therefore the critical period, when the crop was to be saved from an attack, was of a short duration; while in Madras there was no winter to control the disease. In Madras the flowering season was very long, hence a number of sprayings were required to protect adequately the crop.

Mr. Sundararaman said that *Vermicularia Capsici* was found in Madras not only on chillies but also on the following hosts: *Solanum nigrum*, *Solanum xanthocarpum*, *Datura fastuosa*, *Hibiscus esculentus*, and *Canavalia ensiformis*.

Mr. Ajrekar said that *Vermicularia* on chilli fruits was to be found in Bombay as well, and there was also a wilt caused by *Fusarium*.

Mr. Robertson Brown said that in Peshawar a great deal of damage was done to the fruits by some fungus disease.

Mr. Dastur said that he had isolated an *Alternaria* which might be a weak parasite but he had failed to get successful inoculations. There might be some root trouble. In 1917 considerable damage was done to chilli plants, in Bihar, by a disease hitherto not recorded in India. This caused a wet rot of the young twigs. It was due to *Choanephora cucurbitarum*. There was not a trace of this disease last year, possibly on account of the failure of the monsoon. Two more diseases were discovered this year, one caused by a sclerotial fungus, while the cause of the other was unknown. This latter disease generally originated from a fork and blackened the stem. The discoloured area then turned white in patches. On these whitened areas, raised blisters were developed which cracked longitudinally.

Mr. Ajrekar said that chillies, brinjal and other solanaceous plants were much affected by a disease which caused dwarfing of the leaves.

The Chairman said that this was a disease allied apparently to mosaic of tobacco and greatly in need of investigation. In many places it was the worst disease of the crop.

The diseases of **tobacco** were next considered.

The Chairman remarked that leaf spot caused by *Cercospora Nicotiana* was of much more importance than he had hitherto thought.

Dr. Shaw said that in 1917 the ryots in the vicinity of Pusa had sown seeds and planted out seedlings much earlier than usual to avoid the depredations of " tokra " (*Orobanche*) ; this early planting out of tobacco appeared to be specially favourable for the development of *Cercospora.*

The Chairman said that the disease did not seem to spread much. He had kept under observation for 2 months an area where leaf spot was bad, but the disease had not so far gone beyond this area. He suggested that spraying could be tried on young leaves but not on old because the spray mixture affected fermentation.

Mr. Robertson Brown said that *Nicotiana rustica* was grown in Peshawar and no leaf spot had so far been observed.

Dr. Shaw said that as regards *Orobanche* in Bihar, he had nothing more to say than what was already published. It did not occur in Peshawar, while it occurred in the Punjab, but Peshawar tobacco grown in Pusa had been badly infected with " tokra."

Mr. McRae said that he was trying to find out how long the seeds remained viable in the soil. He had allowed *Orobanche* to seed in pots four years ago, and since then the pots had been sown with tobacco every year, and every *Orobanche* that appeared was systematically removed before flowering and setting seed. When the tobacco plants were dead, at the end of the season, they were cut out, and the pots were covered with cloth to prevent any fresh infection of the soil with *Orobanche* seed. At present the original infection of 4 years ago was still giving *Orobanche* plants in the pots.

Referring to diseases of **jute,** Dr. Shaw said that, in 1917, jute on Pusa Farm suffered badly from an attack of *Diplodia Corchori. Diplodia Corchori* was originally collected in 1910, but was then considered as an unimportant occasional parasite. The first symptom of the disease was the appearance of a black band on the stem ringing the plant. The plant then dried up and was left standing as a black stick. From 20 to 30 per cent. of the crop were affected. He had succeeded in producing artificial infections. The infection in the field appeared to begin at the base of an aborted lateral shoot. Such shoots were common in the variety of jute grown in Pusa, as the plant did not branch to any extent until near the apex.

A curious fact was that the disease was worse on a well-grown crop. Poorly developed stems did not get it. Thus, late sown jute which never reached the maximum size and thickness seemed to be immune to this disease. Among stems over 1 inch in thickness or over 5 feet in height, however, as much as 25—30 per cent. might be diseased.

Mr. McRae compared this to a root disease in coffee which appeared to be restricted to plants over 5 years old.

Dr. Shaw mentioned a parallel case in the parasitism of *Polythrincium Trifolii* on *shaftal* (*Trifolium resupinatum*) in Peshawar. This fungus did not attack *shaftal* until the plant had reached a certain size. In 1917-18 twenty tons of jute seeds grown in Bihar were treated with a 2 per cent. solution of copper sulphate, before sending them to Eastern Bengal, to ensure that *Diplodia* spores were not distributed along with the seeds.

In discussing the diseases of **palms,** the Chairman inquired whether the coconut disease at present causing such alarm in Ceylon had as yet been observed in South India. It was characterized by dropping of the immature nuts, and was said to be caused by a *Phytophthora*.

Mr. McRae said that on the West Coast a certain amount of coconuts dropped every year. He had generally found *Pestalozzia* on the fallen nuts but not *Phytophthora*.

Mr. Sundararaman added that *Pestalozzia* killed buds and seedlings. This disease was sometimes very serious but could be checked by spraying with Bordeaux mixture. He thought the dropping of the nuts was also due to *Pestalozzia*.

Mr. McRae said that the bleeding disease was becoming more important in South India. The fungus associated with it was also common on sugarcane. He was studying the fungus in culture. He had successfully infected coconut seedlings 2 to 3 years old, but had failed to inoculate stems.

The Chairman remarked that in Jamaica Ashby had found *Phytophthora palmivora* as the cause of one form of bud rot of coconuts. Thus this fungus, originally only known from India, had now been found in the West Indies where bud rot had hitherto been considered to be due to *Bacillus coli*. *Thielaviopsis* was common on palms in Pusa but it did not cause any disease. He was not sure if it was the same species as that associated with the bleeding disease of coconuts. In any case it differed from the species found on sugarcane in India. In the Federated Malay States a species of *Helminthosporium* did much damage to the leaves.

Mr. Hector said that at Haldibari, in Jalpaiguri District, there was a very serious disease of areca nuts which was causing much

damage since the last five years. The trees died with the symptoms of bud rot.

Dr. Shaw said that when he was touring in Eastern Bengal in connexion with the jute disease last August, he went to Haldibari but he was unable to examine the disease on account of high floods.

The Chairman said that wilt disease was the most serious problem in **cotton.** Buri cotton was the only resistant variety so far found. A root rot of cotton in the Punjab was being investigated but the cause was at present obscure.

Mr. Sundararaman said that in Madras they had a leaf spot of cotton, which seemed to be of bacterial origin. The spots were regular and angular, and were similar to those caused by the fungus *Cercospora.*

Some diseases of **fruits** were next discussed.

Mr. Ajrekar said that in Dharwar and Ratnagiri mango trees were severely attacked by mildew (*Erysiphe* sp.). Pomegranates were attacked by a disease due to a species of *Phomopsis* which caused a wet rot.

The Chairman said that in India much of what was commonly known as scab of citrus was canker due to *Pseudomonas citri.* This bacterial disease was recently reported from America and Africa, and had been found to be widely distributed in India. It was first collected in Peshawar about 2 years ago but was possibly of long standing in India, previous cases having been erroneously diagnosed as scab. It was not here a major disease. The Imperial Agricultural Bacteriologist had investigated it and obtained successful inoculations with an organism apparently identical with that described in the United States and South Africa.

Mr. Robertson Brown said that it was worst on lemons ; certain varieties were very much affected near Peshawar.

The Chairman suggested that diseases of vines and temperate fruits could be more conveniently discussed under Subject III. This was agreed to.

A few diseases of **fodder crops** were next referred to.

Mr. Sundararaman said that in Madras a lucerne crop grown from seed obtained from Basra had been badly rusted last year. Another disease of lucerne was the mildew caused by *Oidiopsis taurica.*

Mr. Ajrekar said that in Bombay lucerne suffered from *Rhizoctonia* and *Uromyces Medicaginis.* Mr. Robertson Brown said that in Peshawar *Polythrincium Trifolii* was a parasite of mature *shaftal* (*Trifolium resupinatum*). This fungus only attacked the crop when a certain size had been attained and was a limiting factor in baling *shaftal* for hay.

The Chairman said that the more the fungal diseases of crops in India were investigated the more evident it became that they were a factor of great importance in regard to the food supply of the country. He was particularly struck with the spade work that had been done in Bombay in determining the diseases that required investigation, and wished to move the following **resolution** :—

"That in view of the work already done with the present limited staff and equipment, and in view of the number of important diseases of crops awaiting investigation in Bombay, this meeting recommends the early expansion of the mycological section of the Bombay Department of Agriculture so as to secure an adequate staff and equipment." Resolution II.

Mr. Ajrekar seconded this.

The motion **was carried unanimously.**

Mr. Kulkarni enquired whether the meeting might discuss the general failure to expand mycological work in the different provinces.

The Chairman deprecated any such general discussion. He thought it was best to consider at these meetings the case of any particular province that produced evidence that it was ripe for expansion. Mycological work was actually expanding at the present moment in some provinces. He thought that they might justly advocate the appointment of a man to Burma, for, though there was no Burma representative present, the Pusa staff had ample experience of the necessity for such an appointment, especially in connection with the diseases of rubber.

Mr. Robertson Brown said that mycology was a highly technical and specialized subject, and he preferred to see such work as was needed in his province carried out at Pusa.

Mr. Hector stated that as far as Bengal was concerned, Pusa was near the province and had far greater resources for mycological investigation than they could ever get in Bengal.

Dr. Shaw said that in a country such as India mycology was a subject which was better carried out at 3 or 4 centres than by individual isolated workers in different provinces. Burma, from its isolation, must have its own mycologist, but for the rest of India he favoured 3 or 4 centres, such as Pusa, Coimbatore, and Poona, in which the mycological work of the provinces in which they were situated and of adjoining areas might be done. For example, the mycological work of the Central Provinces might perhaps be carried out from Poona as that for Bengal was being done by Pusa.

The Chairman said that Poona should certainly be made a centre for mycological research.

SECOND DAY.

The meeting proceeded to discuss—

SUBJECT II.—DISCUSSION OF THE PROPOSAL TO FORM AN IMPERIAL BUREAU OF MYCOLOGY IN ENGLAND, WITH SPECIAL REFERENCE TO THE DIRECTIONS IN WHICH THE BUREAU MAY BE MADE MOST USEFUL TO COLONIAL AND INDIAN MYCOLOGISTS.

The Chairman said that, during the later stages of the war, there assembled in London a conference of the Premiers and other leading statesmen of the Empire entitled the "Imperial War Conference." This body was not only concerned with the discussion of matters immediately connected with the war, but also considered questions regarding the development of certain of the relations between the different Dominions and other Oversea Possessions and the Mother Country. At one of their meetings last summer a resolution was passed to the effect that it was desirable to establish an Imperial Bureau of Mycology for the purpose of supplementing the work of the Imperial Bureau of Entomology, and that the necessary steps should be taken to obtain the funds for its maintenance from the Governments concerned. As soon as he saw the announcement of this resolution in the press, he recommended to the Agricultural Adviser that the proposal should be supported, if referred to him for opinion. This had been done, and he was hopeful that the Government of India would endorse this view, having regard to the fact that similar support was already given to the Imperial Bureau of Entomology and the Bureau for Tropical Diseases.

He said that ever since the outbreak of the war the question of obtaining within the Empire that assistance in certain branches of mycological work which previously they sought in foreign countries had been constantly present in his mind. On several occasions an opportunity arose of representing the difficulties that had arisen owing to the restriction of intercourse with foreign countries, temporary or permanent as the case might be, to those who were likely to be in a position to assist in their removal. He did not doubt that other colonial mycologists had done the same, and it was, perhaps, partly due to those representations that the present proposal had been made.

Now that the great majority of those interested in the development of economic mycology in India were present, this appeared to be an excellent opportunity of considering the functions of the proposed Bureau from their point of view, of welcoming its formation, and of discussing the directions in which the Bureau could be of assistance to them in India.

In order to form some idea of the working of the allied Bureaux of Entomology and of Tropical Diseases, he thought it would be sufficient to give a very brief sketch of their activities, and said that the Imperial Bureau of Entomology was an expansion of the previously existing Entomological Research Committee, brought about in 1913 through the agency of the Colonial Office. Its functions were stated to be to—

(1) organize a system for prompt identification of all injurious insects for Departments of Agriculture or Public Health :

(2) publish a monthly periodical for summarizing British and foreign literature (" The Review of Applied Entomology ") :

(3) compile a card index to literature, past and present, and so be able to supply information in response to inquiries :

(4) develop in various other directions as might be found advisable.

The Bureau was organized under a managing committee of a number of distinguished scientific men, with Lord Cromer as chairman (since succeeded by Lord Harcourt), and representatives of the Foreign and Colonial Offices and of the self-governing Dominions and India. A well-known entomologist (Mr. Marshall) was appointed as Director and given a permanent staff, scientific and clerical. The funds were provided by the various Governments concerned (India subscribed £500 a year), and amounted to between £4,000 and £5,000 annually.

At present, in addition to these activities, a quarterly bulletin of original research (" The Bulletin of Entomological Research") was published by the Bureau. Large collections of named insects were distributed to various centres in Great Britain and abroad. Assistance had been given to various colonial entomologists in the preparation of illustrations for their publications. A summary of legislation against injurious insects in the British Colonies had been (or was being) compiled, and, most important of all, the Bureau had given direct assistance in certain inquiries of Imperial importance by providing men to undertake special missions, the cost of which had been borne by the Governments interested. Thus both in regard to the *Stegomyia* survey in connection with the possible spread of yellow fever consequent on the opening of the Panama Canal, and in the study of *Glossina* in connection with sleeping sickness, the Bureau had taken an active part. It has also administered the Carnegie fund for the training of students in practical methods of applied entomology by sending them to the United States. In 1914, no less than 86,000 specimens were sent in for

determination. The number of journals abstracted and of separate articles reviewed ran into four figures, and the Bureau was always ready to supply any further information that might be required as to a particular article, and even at times to issue duplicates on loan.

The Bureau for Tropical Diseases developed in a similar way in 1911 out of a previously existing organization, the Sleeping Sickness Bureau.

The duties of the new Bureau were defined as being to—

(1) publish periodical bulletins containing classified summaries of the current literature of the tropical diseases of men and animals :

(2) prepare and keep up-to-date classified lists of references, and maintain in its library a classified collection of reprints of recent papers which could be consulted by bacteriologists and medical officers on leave from the tropics :

(3) answer inquiries from workers on tropical diseases :

(4) publish from time to time accounts of recent advances in the knowledge of the various diseases, with indications as to the openings for research which appeared to be most promising :

(5) perhaps publish, as occasion arose, popular pamphlets on tropical diseases for the benefit of the general colonial residents.

Its main object was to collect, condense and co-ordinate the numerous publications in different languages (translating where necessary), and to ensure that the results obtained in one part of the world would be rapidly made known to those working at the same subject in other countries. It would be a central collecting and distributing agency. Ultimately it would possess a unique collection of publications relating to tropical medicine, and its library and the services of the staff of the Bureau might be expected to be of the greatest value to those who required information on specific points.

It was suggested that as the study of the current literature of tropical medicine would, no doubt, bring to the notice of the Director of the Bureau and his assistants various points which required investigation, it might be possible for them, with the expert members of the Committee of Management and officers on leave, to carry out the research work at the Lister Institute or some other laboratory in Great Britain possessing the necessary facilities.

The organization of the Bureau was apparently similar to that of the Imperial Bureau of Entomology, with a Managing Committee

of distinguished scientists and official representatives, and a permanent Director and staff.

He thought that it was reasonable to suppose that the Imperial Bureau of Mycology would be organized on much the same lines as in the two other cases. There would be a Committee of distinguished experts with a high official or non-official layman as Chairman and representatives of the British Government and of the Dominions and other oversea parts of the Empire, and there would be a permanent scientific and clerical staff under an expert Director.

If the existing institutions were taken as a guide, it might be supposed that the duties of the new Bureau would be to—

(1) organize a system for the prompt identification of all injurious fungi for Departments of Agriculture and other similar bodies :

(2) publish a periodical for summarizing current literature on plant diseases, British and foreign :

(3) prepare and keep up-to-date classified lists of references to the past and present literature of the subject, and establish a library open to consultation by plant pathologists :

(4) answer inquiries from plant pathologists in the colonies.

Whether it would have other functions was probably dependent on circumstances. It would be noticed that the Bureau of Entomology had taken a direct part in certain enquiries but not on any very large scale, and that of Tropical Diseases proposed to undertake research at home, but whether it had done so to any large extent he was unable to say. He did not doubt that the opinions of the actual workers in the colonies as to the directions in which the Bureau could be made most serviceable would receive every consideration, and it was for the purpose of discussing this most important question from the members' point of view that he had proposed its inclusion in the programme of the meeting.

He would suggest first that they pass a resolution in somewhat general terms as follows :—

Resolution III.

"That this meeting, representing practically the whole of the mycological workers in India, welcomes the proposal to establish an Imperial Bureau of Mycology to serve as a centre for the accumulation and distribution of information on the diseases of plants in the colonies."

Mr. Ajrekar suggested that the word "colonies" be altered to "British Empire" so as, technically, to include India. The Chairman accepted this alteration, and said that he had used "colonies" in that sense.

The **motion as amended** was then put to the meeting, Mr. McRae having seconded it, and **was carried unanimously.**

The Chairman then said that, proceeding to consider the functions of the Bureau, the meeting might begin by examining the four already stated to be probable functions in view of the experience of the two allied Bureaux of Entomology and Tropical Diseases.

With regard to the first of these—the identification of injurious fungi—he imagined that there would be general agreement that this was one of the most important matters in which the Bureau could be of assistance. He said that he need only give two instances from his personal experience of the great value of work of this nature, apart altogether from the advantages of being able to have their specimens named for them.

The fungus *Fomes semitostus* B., originally described from the Khasi Hills in India, was recorded some years ago as one of the most destructive parasites of the *Hevea* rubber tree. At that time he was engaged in preparing the schedule under the Destructive Insects and Pests Act, and at first sight there appeared to be no reason to take precautions against the introduction of this fungus into India since it had been originally collected in this country. But he was assured by Mr. Anstead that he had not seen a case of attack in his wide experience of rubber estates in South India, and accordingly the fungus was listed, though with some hesitation. Shortly afterwards it was established by critical examination at Kew that the rubber parasite was not *Fomes semitostus* at all but *F. lignosus* Kl., a fungus not known to occur in India up to date. Had it not been listed, the free importation of rubber stumps from countries where it occurs would very probably have added another and a very serious disease to those of our Indian rubber plantations.

The other case is that of pink disease which is a very widespread and dangerous parasite of a large number of cultivated plants. In the east it was described as being caused by *Corticium salmonicolor*, whereas a very similar disease, also called pink disease, was known in the West Indies and attributed to *Corticium lilacinofuscum*. He was instrumental in getting good material of both these diseases submitted to expert examination by scientists who had made a special study of the genus, and they were found to be identical. The very considerable literature and practical experience in the two hemispheres was thus made available to workers in either.

These were cases where the existing facilities in Great Britain were sufficient to enable the difficulties to be cleared up, but it is certain that there are many others in which it would not be possible to get reliable advice in England at present. It has not been the specific function of any institution to deal with such cases, and even

in the two referred to above, there was much unnecessary delay and confusion owing to the workers on these fungi not feeling in a position to refer their difficulties to experts whose definite duty it was to deal with them. In both cases, the critical examination was deferred until the colonial mycologist concerned went home on leave.

Even in the mycological herbarium at Kew, which was the chief herbarium in Great Britain, the collections of tropical parasitic fungi were inadequate, and had not kept pace with the great development of tropical mycology during the past twenty years. It was practically certain that the best centre for the new Bureau was Kew, but it would be their first duty so to supplement the existing collections as to make them representative of the fungus flora of the colonies, and especially of those in the tropical and sub-tropical zones. For this the co-operation of all would be required, though it would be advisable to be as moderate as possible in their requests for identifications until a large collection of named species had been built up.

With regard to the second point—the publication of an abstracting journal—he was bound to say that he personally regarded with some alarm any addition to the already unwieldy mass of periodical literature dealing with plant diseases. But he recognized that at Pusa they were perhaps more fortunately situated in regard to access to literature than in many places, and he would like to learn the opinion of the meeting as to the utility of such a journal.

The third point—the formation of a library and the maintenance of classified lists of references to literature—is one on which, he imagined, all would be agreed. There was already at Kew a magnificient botanical library, and with this as a foundation, the addition of complete series of agricultural and other less strictly botanical publications in which the literature of their subject was at times found would not present any great difficulty. It would be their duty to ensure that any publications on mycological or plant disease questions in India were promptly supplied to the Bureau.

The fourth point—the answering of inquiries regarding matters in which plant pathologists were interested—was perhaps not of very great importance outside the directions referred to above. Most inquiries would presumably be in regard to identifications or literature references. It was unlikely that a Bureau in London could be of much use to members in other matters as it could not be expected to give assistance in matters of scientific research.

Outside of these four lines of activity, there was the big question whether the Bureau should directly engage in research in connection with diseases of Indian crops and other plants. He held very

strongly that practically all such research could best be conducted on the spot. Even where the same crop was affected by the same disease in England and India, investigators could not gain more than general principles from work conducted elsewhere. Their application must be made under local conditions. Practically every colony of importance had now its own research institute and expert staff, and it was better to increase the research workers actually on the spot than to spend money on research in England with a view to applying the results in other countries, such as India.

The case was quite different when the position of the colonial mycologist home on leave was considered. It might well happen that he had work in hand which he could carry on at home, and there would be every advantage in providing laboratory accommodation and facilities for such workers—the number of whom at any one time would not be large. This was a matter upon which he hoped that the meeting might be able to make a representation by means, perhaps, of a separate resolution.

It would have been noticed that one of the directions in which the Bureau of Entomology had given assistance had been in the supply of trained men to undertake special missions. There was perhaps not the same scope in mycology for work of this nature, but it would obviously be of advantage if the Bureau arranged to keep in touch with research workers in England and the colonies, so that in case of need the Bureau would be able to advise where to obtain the temporary services of an expert on some particular matter of urgency outside the capacity of a local department to deal with.

It was not yet known how far the proposed Bureau would expand. One of the subjects down on their programme was the application of the science of genetics to the control of plant diseases. This opened up a most important side of the work of the plant breeder, and since general principles in this matter are as yet far from being fully developed, and work done in any one country was likely to serve as a guide to workers elsewhere, the hope might be expressed that the Bureau would be the means of directing the attention of the plant breeders in England and elsewhere more closely to the question of breeding for disease resistance.

There was no doubt that other useful fields of activity would be found as the Bureau gained in experience and economic mycologists in the Empire were brought more into touch with one another than in the past. He thought that he had shown that the foundation of an Imperial Bureau of Mycology was likely to be of the greatest service to them in India, and he suggested for consideration by the meeting the following resolutions.

"That this meeting is of opinion that an Imperial Bureau of Mycology would be of the greatest value to plant pathologists in India, if it is organized on somewhat similar lines to the existing Imperial Bureau of Entomology, and has as its chief functions—

(1) the organization of a system for the prompt identification of all injurious fungi for Departments of Agriculture and other similar bodies :

(2) the publication of a periodical for summarizing current literature on plant diseases, British and foreign :

(3) the preparation of classified lists of references to past and current literature of plant diseases, and the establishment of a reference library open to consultation by plant pathologists :

(4) the answering of inquiries from plant pathologists."

The Chairman pointed out that the resolution of the Imperial War Conference stated that the establishment of the Imperial Bureau of Mycology would be for the purpose of supplementing the work of the Imperial Bureau of Entomology. He would like to know if the meeting had any objection to the Imperial Bureau of Mycology being attached to the Imperial Bureau of Entomology.

Mr. Tunstall thought it would be an advantage to have the Imperial Bureau of Mycology attached to the Imperial Bureau of Entomology.

Dr. Shaw said that the Imperial Bureau of Mycology might supplement the work of the Imperial Bureau of Entomology without being in any way subordinate to it. He thought that they should make it quite clear that the Imperial Bureau of Mycology was not merely a branch of the Imperial Bureau of Entomology.

The Chairman proposed to insert the words "but naturally independent of" into the resolution which would then read :—

Resolution IV.

"That this meeting is of opinion that an Imperial Bureau of Mycology would be of the greatest value to plant pathologists in India, if it is organized on somewhat similar lines to, but naturally independent of, the existing Imperial Bureau of Entomology, and has as its chief functions—

(1) the organization of a system for the prompt identification of all injurious fungi for Departments of Agriculture and other similar bodies :

(2) the publication of a periodical for summarizing current literature on plant diseases, British and foreign :

(3) **the preparation of classified lists of references to past and current literature of plant diseases, and the establishment of a reference library open to consultation by plant pathologists :**

(4) **the answering of inquiries from plant pathologists."**

The motion was seconded by Dr. Shaw and **carried unanimously.**

Mr. Dastur suggested that it would be an excellent thing if the Bureau published its list of references either in book form or as a card catalogue.

The Chairman said that such a catalogue might be published in book form which would allow of the references being cut out and pasted on cards.

Dr. Shaw inquired whether it was proposed to include the United States Department of Agriculture literature in such a catalogue, and pointed out that a very complete catalogue of such literature already existed.

The Chairman thought that the new catalogue should be complete.

Mr. Tunstall said that indexing in sections might reduce the bulk of the catalogue to be sent to any one man.

The Chairman thought that the actual form of the catalogue was a matter which might be left for the present, the question was whether its publication was desirable.

Resolution V. Mr. Dastur moved—"**That the preparation and distribution of a classified index to past and current literature in plant disease should be one of the chief functions of the Imperial Bureau of Mycology.**

Dr. Shaw seconded the **motion** which **was carried unanimously.**

The Chairman then raised the question as to whether the Bureau should itself engage in original research or should publish original research in a journal of its own.

Mr. Dastur favoured the publication of original research by the Bureau. He cited the fact that it was difficult to find a suitable medium for the publication of short notes.

Dr. Shaw suggested that such short notes might be included in the periodical for summarizing current literature.

The Chairman pointed out that the "Experiment Station Record" did not do this, and that the Bureau of Entomology had two journals—one for original research, and one for summarizing current literature. He was against including original research in a publication devoted to summarizing. With regard to short notes, the "Annals of Applied Biology" offered a suitable medium for

publication. A movement was on foot in India to obtain a journal, under the auspices of the Asiatic Society of Bengal, which would take this type of article.

Mr. Ajrekar suggested the publication of a Year Book in each province.

The Chairman said that this would mean 8 or 10 new periodicals.

Mr. McRae thought that the scheme of the Asiatic Society of Bengal would meet all their needs.

Mr. Mackenna suggested that a section of the "Agricultural Journal of India" might be opened for this work until the new journal of the Asiatic Society of Bengal was established.

Mr. Tunstall said that in that case the new journal might not be needed.

The Chairman thought that the new journal would be needed owing to the large number of other scientists, *e.g.*, chemists, for whom it would be an advantage. Chemists published in the "Journal of the Asiatic Society of Bengal" at present. He thought that the sense of the meeting was against any multiplication of journals for publishing research, and the single new journal under the Asiatic Society of Bengal would meet all their needs. There remained the question whether the Bureau should engage in research work itself.

Dr. Shaw said that if the Bureau had a laboratory the staff would undoubtedly work in it, and it seemed hardly possible to lay down what they should or should not do. They would, of course, be mainly engaged in systematic work.

Mr. Anstead said that he wished to emphasize the importance of mycological research work being done under local conditions. He cited the case of *Phytophthora* on rubber and its behaviour in India, Burma, Ceylon and Federated Malay States.

Mr. Tunstall agreed with Mr. Anstead, and said that research work done in England on tropical diseases would be of little use. It was sufficiently difficult to do satisfactory work on material which had only made a relatively short journey on the Indian postal system.

Dr. Shaw said that the work which had recently been done at Kew in identifying the fungus *Polyporus Shoreæ* on *sal* was typical of the work which they might expect the new Bureau to carry out.

The Chairman pointed out how long it had taken to get certain diseases identified. The root rot of rubber was a case in point. A direction in which the Bureau might be of great assistance was in finding specialists for particular lines of work. Such occasions often arose in the planting industries, and the Bureau of Entomolgy already did this for entomological questions.

Mr. McRae said that such advice would be very useful in the recruitment of a rubber mycologist for Madras.

The Chairman said that the *ufra* disease in Bengal might call for a specialist. The India Office was not always in the best position to recruit a suitable specialist in such cases, and the Bureau might give useful help. He wished to move the following resolution :—

Resolution VI. "That while not in favour of the Bureau engaging in research work on its own account in the diseases of plants in India, this meeting would welcome any facilities that could be given to research workers from India and the colonies to pursue their investigations when temporarily in England, and for this object urge that laboratory space and equipment be provided for such workers at the seat of the Bureau. Furthermore, this meeting hopes that the Bureau will endeavour to keep in touch with the research workers engaged in the study of plant disease in all its aspects, so as to be able to advise in the selection of experts required for the investigation of particular diseases of urgency, which it may be beyond the capacity of any particular colony to provide from amongst its own staff."

Mr. McRae seconded. The motion was carried unanimously.

The Chairman then moved—

Resolution VII. "That as the Bureau expands and gains in experience, this meeting does not doubt that other fields will be found of equal importance for its activities, and in particular wishes to emphasize the importance of the application of the science of genetics to the control of plant diseases, and to express the hope that the Bureau may be able to keep this matter prominently before those engaged in the study of plant breeding."

Mr. Anstead seconded. The motion was carried unanimously.

Mr. Mackenna said that in view of the importance of the subject discussed, he wished to move the following resolution :—

Resolution VIII. "That a copy of the minutes on Subject II be forwarded to the Agricultural Adviser to the Government of India in order that that officer might submit a summary to the Government of India."

Mr. McRae seconded the motion which was carried unanimously.

The meeting then proceeded to consider—

SUBJECT III.—A DISCUSSION ON SPRAYING AND FUNGICIDES.

The Chairman asked Mr. Tunstall to give the meeting the benefit of his experience.

Mr. Tunstall said that he favoured the use of concentrated prepared mixtures which required no trouble in making up. He

doubted if it were possible to obtain adequate supervision in making up a solution like Bordeaux on a tea estate. The proprietary mixture Bordorite did not keep well. He was now trying a powdered Burgundy mixture. Sprayers must be simple and strong to stand handling by Indian coolies. A four-nozzle attachment was used for spraying tea and thus bushes were sprayed on both sides of the operator. The nozzle which he favoured was made locally, and had been described in detail in the "Indian Tea Association Scientific Department's Quarterly Journal," 1918. Spraying was increasing to a marked extent in the tea districts.

The use of caustic soda washes to kill epiphytes was only beneficial in certain districts (Darjeeling)—a solution up to the strength of 2 per cent. could be used without damaging the trees. Lime sulphur was used against copper blight, brown blight and red spider—he had no data as to its efficacy against blister blight. Experiments in spraying tea with copper sulphate solutions had shown that there was a small stimulatory effect of spraying on the yield of tea.

Mr. Anstead inquired if there was any control sprayed with water in this experiment.

Mr. Tunstall doubted if this was necessary. Spraying with copper sulphate solutions prepared from certain proprietary mixtures seemed to bring on attacks of red spider. In reply to the Chairman, he stated that there was a sugar, dextrose, in the solution used.

Mr. Robertson Brown stated that red spider followed the rise and fall of humidity in the air. In England it was a common practice to spray glass-houses every evening with water to prevent the development of red spider. Dryness was favourable to its occurrence; sulphur painting on peach trees and on pipes in glass-houses was common as a preventive of red spider.

The Chairman remarked that sulphuring vines was said to increase the yield.

Mr. Anstead remarked on the use of sulphur in Madras as a manure for groundnuts.

Mr. Patwardhan then gave some account of the spraying of vines in Bombay against vine mildew. The work was commenced in 1909 and finished in 1918. In the first three years it was purely experimental, and in the following years partly propagandist and partly experimental. Ten centres of culture were dealt with.

I. *Experimental.*—The experiments were conducted in cultivators' fields at Nasik in three seasons, with two supplementary centres at Ganeshkhind Gardens and Mundhva. The results and conclusions arrived at were reported in the Bombay Agricultural Department Bulletins Nos. 36 (1910), 45 (1911), and 51 (1912)

All the cultivators of Nasik, which was the chief centre of vine-culture, saw with their own eyes and in their own fields all the details of the experiments.

II. *Propagandist work.*—Immediately on the conclusion of the experiments, a meeting was held in Nasik which many vine-growers attended. A lecture and a long informal discourse followed as regards the treatment including the means of obtaining the ingredients, preparing the mixture, spraying tools, etc. Then the further work of popularizing the treatment was left to the district staff of the agricultural department. No progress was made for one year, mainly for (1) lack of expert knowledge on the part of the staff and (2) their being employed on their own primary and separate duties. The work was then taken over by the botanical staff again and one or two centres dealt with each year. The staff employed consisted of one man who was deputed to the centre to stay during the "sweet-crop" season, and who was controlled by frequent visits to the place by Mr. Patwardhan from head-quarters at Poona. From 1915 the Divisional Inspectors of Agriculture secured some good cultivators who lent their vines for demonstration plots at no cost except that of spraying. It must also be mentioned that absolutely no help was asked of any of the Revenue Department officers, except in one recent instance where the Assistant Collector of Ahmednagar presided at a meeting of cultivators at Nagar. In recent years, the District Overseers and Divisional Inspectors had ungrudgingly extended their help and sympathy, and used their influence with cultivators of their acquaintance. Departmental leaflets were circulated, but they were not read and followed even by those who could read and write.

III. *Methods.*—The methods followed consisted in each place of—

1. Treating 200 vines in four or five vineyards, in different directions in the village, and leaving the rest of the vineyards for comparison.
2. Having an expert in the place to observe and seize the right time for spraying.
3. Getting the cultivators to carry out normal agricultural operations for the sprayed vines as is generally done in vineyards.
4. Making no claim on the improved crop from the treated vines, while offering to pay any damage that might occur on account of the spraying. No damage was ever done and no payment was ever made.

IV. *Co-operation.*—The cultivators' co-operation was secured with ease, and the following factors had contributed in a great measure in obtaining it :—

1. The success of the experiment in the fields of cultivators themselves.
2. Absence of any interference with cultivators' own ways in other respects.
3. Free discussion and expert advice on the spot.
4. Helpful and sympathetic attitude during the progress of demonstration.
5. Rendering actual material help gratis in some cases.
6. Expert knowledge with regard to other difficult matters connected with the original propaganda work, *e.g.*, solving difficulties regarding removal of stains and poisonous character of the fluid.
7. Help in securing tools and ingredients of spraying.
8. Personal influence of the demonstrator.

V. *Results.*—As a final result of all that had been done in the course of the last 10 years, the following conclusions had been reached—

1. The frequency of the spraying required had been reduced to three applications in the " sweet-crop " season. The first of these was of full strength, the second might be either full strength or half strength, and the third was always half strength. Where the " sour-crop " got a sale (as in Nagar) two sprayings were needed in that season : one full strength and the other half strength.
2. The formula of the mixture used was—

   3 lb. of copper sulphate in 2 gallons water.

   2 lb. of lime in 2 gallons water.

   $2\frac{1}{2}$ lb. of soft soap in 2 gallons water.

   The whole made up to 25 gallons of water.
3. The sprayer used all along was the Prize bucket pump with Acme nozzle. Other sprayers such as Auto-sprayers, Knapsacks, etc., were not tried sufficiently to give comparative figures of the quantity of fluid consumed by each. There was no doubt a considerable waste of spray material with the Prize bucket pump which could be saved by the use of better nozzles. The Foot Pump of Meyer's had a nozzle which gave a very fine spray, and

this pump (the cost of which was not much more than that of Prize bucket pump) needed further extended trial. Some people had bought them on the Department's recommendations.

4. No stains were left on the berries if the last spray was of half strength, or if the last spraying was done with ammoniacal solution of copper carbonate.
5. No difficulty had been felt with respect to marketing.
6. All the cultivators of vines knew the treatment, and gave it with more or less individual efficiency. The spraying had now become one of the ordinary and compulsory routines of field operations. A vineyardist blamed himself if he failed to spray his vineyard.
7. The propagandist work had been intensive and thorough, and no part was left untouched. The success of the work need not be put in calculated figures but was proved by the realizations of the cultivators.
8. Before spraying was introduced, a large profit or a total loss was a matter of chance or speculation. But now profits were certain, and no one hesitated as before to plant a vineyard if he had the ways and means of doing it.
9. The cost of spraying one acre was now Rs. 28-6 at the present high market rates of materials. The extra cost involved was easily met out of the large profits secured.
10. Before the spraying was known cultivators used to dispose of their crops to Bagwans (speculating middlemen) on *Afat Asman*, which was a system of forward sales on the appearance of flowers and in which the cultivator was burdened with the risk of receiving no payment if the crop became mildewed. Now this system of forward sales was done away with. The cultivator waited till the crop was nearly ripe which enabled him to estimate its value before selling to a Bagwan.
11. Other materials, such as potassium sulphide and ammoniacal solution of copper carbonate, were used on two occasions in comparison with Bordeaux, and they were found less satisfactory.

Mr. Robertson Brown said that in Peshawar peaches must be sprayed against leaf curl. Holder sprayers and Burgundy mixture were used. The disease was entirely controlled by a single spraying at the right time.

The Chairman pointed out how necessary it was to do experiments before making an assertion as to whether spraying would or would not cure a disease. Practically all the European text-books said that pruning was the only remedy for leaf curl, but when spraying was tried in the United States and Australia and later by Horne in England, its efficacy was proved at once.

Dr. Shaw informed the meeting that Lacto Burgundy had given good results as regards its adhesive properties when used against peach leaf curl in Peshawar.

Mr. Tunstall remarked on the present high price of sprayers.

Mr. Venkata Rao said that in Mysore they were making Holder sprayers. The price was Rs. 45 for a 5-gallon sprayer.

Mr. Kulkarni said that a 1-gallon sprayer from England cost Rs. 37.

The Chairman thought that if spraying was ever to become common in India sprayers must be sold for about Rs. 20. It was unfortunate that the home-made Mysore sprayers were not at present for sale to the public, and were only made for Mysore Government. If the shortage of copper sheeting was hindering the manufacture of sprayers, it might be necessary to approach Government to facilitate supplies.

Mr. McRae said that the spraying of **areca nuts** against Koleroga was being carried out in Madras by district officers. Last year, owing to the short monsoon, only a little disease existed; in the previous season some 40,000 trees were sprayed. A certain amount of vine spraying had been done, but it was difficult to estimate the result of the spraying owing to the variations in yield due to cultural conditions.

The Chairman pointed out that when a disease was first attacked by spraying, the spraying had to be heavy. When the intensity of the disease had been lessened, spraying could be reduced.

Mr. Anstead said that spraying of **coffee** with Bordeaux against leaf disease was giving good results. In one trial, 100 acres were sprayed, and the improvement, not only in the yield but in the quality of the berry, was enormous. The limiting factors were the supply of water and labour. This cost was about Rs. 18 per acre but this should come down to Rs. 10. Koleroga disease was also being sprayed with success.

The Chairman suggested the **use of dusting instead of spraying** where the water supply was deficient.

Dr. Shaw called attention to the increased popularity of dusting in the United States of America. The mixture recommended was a

combined fungicide and insecticide consisting of 90 per cent. sulphur and 10 per cent. lead arsenate. It was recommended against scab in apples.

Mr. Anstead remarked that the legal restrictions on purchase and transport of sulphur prevented its being used much in Indian States.

Dr. Shaw gave some account of spraying upon the orchards in Kumaun. Holder sprayers and lime sulphur, with lead arsenate, were used. Spraying with lime sulphur had almost completely controlled apple mildew on one orchard when the disease was very severe on a neighbouring unsprayed orchard. This was in spite of the fact that the sprayed orchard was at a higher level and in a moister climate.

The Chairman said that he thought that a good machine was the first essential for spraying. He was convinced that early attempts to spray coffee had failed owing to the type of machine used.

The meeting met again at 1-30 p.m. in the Mycological Laboratory for a discussion and examination of specimens of various major, new or interesting diseases.

In the evening Captain de Mello gave a **lecture,** illustrated by cultures and lantern slides, **on** the subject of **medical mycology, mycological technique and the Indian mycoses.**

He pointed out that the subject was still in an embryonic state in India, though these diseases abound in this country. Considered formerly as a mere scientific curiosity, despised by the pathologists who only troubled about ringworm, they had come to occupy a place of considerable importance in medical and veterinary pathology. Just as in bacterial infections, these parasitic fungi were capable of causing polymorphic lesions : the blastomycosis provokes dermic, hypodermic, osseous and visceral lesions, sporotrichosis provokes ulcers and gummata, attacks the mucosæ, the skin, bones, all the organs and tissues, and may simulate syphilis, tuberculosis, the pyogenic infections, and glanders. The same pathological law that polymorphic lesions can be caused by the same agent, and that different agents can cause the same lesion, holds for the mycoses as for bacterial infections. The histological reactions also are similar in the two cases. *Sporotrichum Beurmanni* can provoke degenerescence, inflammation, sclerosis, nephrites, and pneumonia.

For a long time it was believed that localized mycoses, as ringworm, were essentially chronic but benign, and the systemic mycoses, like actinomycosis, were easily curable with potassium iodide and gave no room for general infections such as are seen in bacterial diseases. Nothing could be more wrong. The lecturer

has seen fatal cases of blastomycosis, and the mycosis which is most easily curable, sporotrichosis, can become generalized and cause death. Paltauf observed a fatal generalized attack of a Mucorinæ simulating infectious jaundice, though the localized mucormycoses are usually benign. For the essentially localized Madura foot no other treatment than surgical ablation, which may go as far as amputation, is known.

Toxins have been isolated from several of these parasites—endotoxins from the thrush fungus, hyperthermic and paralysing substances in cultures of *Aspergillus fumigatus*. Aglutinins, sensibilisins, coaglutinins and cosensibilisins have been found in various infections with *Sporotrichum*, *Oospora*, *Oidium*, *Endomyces*, *Trichophyton* and *Hemispora*. The Wassermann reaction, so useful in the diagnosis of syphilis, is also got in actinomycosis, sporotrichosis, and some localized diseases caused by *Microsporon* and *Trichophyton*. Precipitins were found by Widal in sporotrichosis and opsonins by Millhit in the same disease. To complete the series of humoral reactions, the anaphylactic doctrine of Richet has also its application in mycotic diseases. The *Trichophytiæ* are susceptible to the injection of trichophytin, and cuticular, subcuticular and intradermic reactions have been studied in sporotrichosis by various workers.

Finally, to complete the parallel, it is well known that it is possible to confer immunity against mycosis by specific reactions. The rabbit has been successfully vaccinated against endomycosis and the guinea-pig against *Trichophytiæ*. American experiments in vaccinotherapy against blastomycosis have been crowned with the greatest success.

The etiology and pathology of the mycoses also present analogies with bacterial infections. Saprophytic germs from the air, soil, and foodstuffs can turn into parasites. Ringworm and sporotrichosis are transmitted by contagion. Infection may take place through the skin or the mucous tissues, with or without wounding. A rat bite was the origin of a sporotrichosis, which covered the body with ulcers and led to segregation as a leper, in a case which had come under the lecturer's observation. A cure was readily effected with iodide.

To determine the presence of mycelial elements is not enough. Not only must the clinical and pathological features be studied, but the suspected fungus must be cultivated, and its relation to the disease demonstrated through the seric reactions and experimental inoculations.

Mycoses are classified either by the genus of fungus or by the clinical seat of the lesion. Thus there are mucormycoses, pulmonary, facial actinomycoses and the like, names derived from the

genera *Mucor*, *Actinomyces*, acting as parasites on the lungs, face, etc. In some cases special names are used, like tinea, hebra, tokelau, for mycoses caused by specific agents.

For convenience, an artificial division into two great groups may be made—the "Dermatomycoses" and the "Systemic Mycoses."

The lecturer then showed slides of dermatomycoses of the head caused by different fungi. The clinical features were explained, and the technique of the examination of infected hairs described. The characters of the three genera, *Microsporon*, *Trichophyton* and *Achorion*, as they occur naturally in the hair, were demonstrated by means of slides. Next were shown dermatomycoses of the glabrous parts, which, in the lecturer's experience, were the most frequent in India and as yet the least studied. They will certainly constitute the most interesting chapter of Indian medico-veterinary mycology. *Microsporon*, *Trichophyton*, *Achorion*, *Endodermophyton*. and *Epidermophyton* are all concerned in this group of diseases, of which numerous slides were shown. The microscopic study of the scales of the skin does not usually permit of a recognition of the genus of fungi concerned in these diseases as it does in dermatomycosis of the hair, and cultures become necessary. This introduces the most interesting part of the subject from the strictly mycological side—the study of the parasites in artificial culture. It is only of recent years that the plurality of genera such as *Trichophyton* has come to be recognized, and in many cases accurate identification is impossible without the aid of cultures.

In making cultures of these fungi the following principles are useful :—

I. Never to study the dermatomycoses during the rainy months : there are so many *Aspergilli*, yeasts and other saprophytic fungi contaminating the cultures that one's patience is exhausted.

II. To break up the parasitized element as much as possible : in the case of hair its lower part ; in the case of scales, a number of them ; in the case of animal hair only its lower part, intradermic as far as possible, for the higher part is full of spores of ordinary fungi that spoil the culture.

III. To replace in the culture tubes, sterilized in the autoclave, the cotton plugs moistened and turned hard, for others of cotton sterilized beforehand ; and never to cover the tubes with rubber capsules, so that the culture may be regularly aired. To leave these tubes without sowing for a few days in order to reject those that show saprophytic fungi.

IV. To utilize as the principal medium of culture the maltosed or glucosed agar of Sabouraud, the composition of which is as follows: Sugar 4 per cent., Pepton of Chassaing 1 per cent., Agar *q. s.* for solidification; but not to forget various other solid and liquid media, particularly decoctions of fruits, broth of hay, etc., without and with sugar. It is not without interest to remember that in the case of *Endodermophyton indicum*, the lecturer only obtained primary cultures in glucosed broth of hay, and it was these that served for the further subcultures. He would not forget also that one of his pupils, studying the parasites of *Tinea flava* not yet cultivated, obtained in a special agar made with broth of cabbage, a yellow culture that seemed specific, but which was never reproduced—perhaps because the formula of the composition was also lost.

V. To cultivate as many tubes as possible. Some get spoilt, others give pure cultures. In tubes with inclined agar the lecturer sows two fragments, one towards the base, the other in the upper transparent part. This has the advantage of enabling one to observe the culture with the microscope through the wall of the tube, and to make subcultures as soon as development begins. It is necessary to use a very large number of tubes in some cases Only just before coming to Pusa, having occasion to speak to a lady regarding the subject of the lecture that he was preparing, she called his attention to a lesion on two of her fingers that had been attributed, at Oporto, to scrofula. To his great surprise he found his first case of onychosis with trichophytic elements and other rounded bodies either epidermophytic or yeast-like in character. Having only a few culture tubes ready he had sowed a small amount of pus and brought them with him. Unfortunately the yeast developed with such abundance as to cover the other culture, and it was only with considerable difficulty that he had been able to isolate the fungus, working in the Mycological Laboratory at Pusa. It proved to be a *Trichophyton*, sub-group *Megaspora*, perhaps the *Tr. rosaceum* of Sabouraud. The cultures, which the lecturer showed, are still under study.

VI. It is also necessary to cultivate some Erlenmeyer flasks with Sabouraud's agar, because some dermatophytes form such large cultures that tubes are insufficient.

VII. Finally, it is necessary to have ready some tubes with preservative agar (without sugar), because the dermatophytes, in general, show in sugared media white pleiomorphic degeneration forms, that when sub-cultivated continue to show the characters of this degenerescence, both macro and microscopic.

After making the culture, the evolution of the fungus is studied, its macroscopic aspect at different ages (form, colour, plicatures, etc.) and in different media. Cultures of the lecturer's *Trichophyton Viannai* illustrating these characters were exhibited.

Then hanging-drops are prepared in the usual way, glucose or maltose broth being used. At regular intervals these are examined or dry preparations made from them after fixation and staining (pure acetic acid, washed with absolute alcohol and stained with eosin 1/400 solution). Camera lucida drawings can be made at low magnifications either from the hanging-drops or direct through the glass of the tube, using the cultures in the upper thin part of the slope for the purpose. For higher power examinations hanging-drops or slide preparations are used. *Intra vitam* coloration with dilute (1/50,000) solution of neutral red shows the structure of some elements with great precision.

To close this account of the technique, the lecturer then described the method of inoculation. The animal employed for the purpose is the guinea-pig. The skin is shaved, scarified with a vaccinostyle, and a drop of the culture applied. The resulting lesion is carefully observed and the retro-cultures made. Inoculations on the human skin are very inconsistent, especially if made on the same individual whose fungus is under study.

The lecturer then proceeded to describe the practical application of the study of medical mycology. He distinguished between the open mycoses, where the lesions are in contact with the air either because they are developed in open cavities of the body, or because they become ulcerated to the exterior, and the closed mycoses which develop in the tissues of the body.

He described a number of interesting cases of each type. Amongst these was one in which the patient—a Mahomedan servant—had for 12 years been believed to be suffering from cavernous tuberculosis. But Captain de Mello had failed to find the bacillus of Koch and, becoming suspicious, made a mycological analysis of the sputum. This resulted in the detection of *Nocardia* (*Actinomyces*) *bovis* Harz. It was a bronchopulmonary actinomycosis that iodides and arrhenal cured as if by magic.

In another case, a Goanese musician had suffered for many years from attacks of asthma. In the sputum a *Cohnistreptothrix*

was found and on cultivation proved new. The lecturer has described it under the name of *Cohnistreptothrix Rogersi*, after Sir Leonard Rogers, but has had no means of affirming its causal connection with the disease.

The same difficulty has arisen in the case of the yeasts that are found in the air passages and in ulcers and wounds. The lecturer made a special study of yeasts and *Nocardia* thus obtained last year which is now being published.

In the open dermatomycosis, known as Madura foot, histopathological examination is required. The cultures in this case are difficult to obtain.

The closed systemic mycoses present the advantage of freedom from casual ærial contamination. In them the fungus is found almost pure. In two cases of blastomycotic abscess examined by the lecturer, the technique was to gather the pus asceptically, to study the parasitic elements in hanging-drops, to cultivate them in various media such as potato, agar, Sabouraud's medium, carrot, simple and vegetable broth, and the liquid of Raulin. The evolution of the fungus was followed, it was classified, and its pathogenicity to animals studied. In one case the cultures failed, but in the other they succeeded and enabled the fungus to be determined as a new species of *Saccharomyces*. Another systemic case seen was one of sporotrichosis causing subcutaneous gummata. The pus showed short ovular elements of the yeast type, which on culture gave the characteristic chocolate-like growth of *Sporotrichum Beurmanni*. Nothing beyond a few tubes of glucosed Sabouraud medium and an aseptic syringe are required in such cases. The tubes are kept at room temperature, and no special inoculation is usually required. A very simple technique is followed by Gougerot. He lets fall a layer of pus on the side of the tube just above the line of junction between the tube and the agar. The traces of the latter that remain after sterilization are enough to permit a restricted growth that can be directly examined through the glass and the characteristic stars of *Sporotrichum* observed. The diagnosis of a sporotrichosis is now-a-days but little more difficult than the examination of the expectoration for tuberculosis, and much easier than the Widal test.

Medical or veterinary mycology demands on the part of the investigator a few notions of dermatology, a profound knowledge of bacteriological technique, and much patience both for not being disheartened at negative results and for establishing the conclusions arrived at by repeated proofs with cultures and retrocultures.

At the conclusion of the lecture, Captain de Mello gave expression to a warm greeting on the part of Portuguese scientists to their colleagues in British India.

The Chairman, in proposing a vote of thanks to the lecturer, expressed the obligation which all the members were under to him for attending the meeting and presenting such a masterly review of the subject. He was a recognized authority and almost the only worker in the Indian continent on this most interesting and important branch of mycological science. Every one knew of the remarkable development of medical entomology in recent years, and, though it was doubtful if there was the same scope for medical mycology, it was certain that the subject was becoming of increasing importance, and would attract more and more attention as schools of tropical medical research were established. All mycologists were bound to be interested in the growth of this, the youngest branch of their science, and it was very possible that some of those present could take an active part in assisting in the study of these diseases from the mycological side. He was sure they would all reciprocate the friendly greetings of their Portuguese allies and colleagues.

The vote of thanks was carried with acclamation.

At a subsequent period Captain de Mello gave a demonstration in the laboratory of the methods of technique described in his lecture, and was able to establish the existence of several cases of mycosis amongst the servants of the Institute.

THIRD DAY.

The meeting took up the discussion of—

Subject IV.—Diseases of planters' crops.

The Chairman invited Mr. Anstead to open the discussion.

Mr. Anstead said that the chief planters' crops of South India were coffee, tea and rubber. As he had already referred to the treatment of leaf disease of coffee during the discussion on spraying (p. 45), there was nothing more left for him to say on this subject. The root diseases were proving very troublesome, and not much was known about them. A great deal of work was required to discover the source of the trouble and suitable remedies. Mr. McRae helped them a lot but he was so busy that he could not devote much attention to this work. At present the diseased roots were dug out and a fairly heavy dose of lime was applied. This work ought to be done thoroughly to be successful. What species of fungi cause these root diseases was only one aspect of the problem, and it was essential to investigate the relation between the presence of certain shade trees and the incidence of root disease. It had been observed

that five or ten years after the removal of certain shade trees there was an outbreak of root diseases in the vicinity. What the planters wanted to know was which shade trees were responsible for root disease.

The Chairman inquired what was his idea of the most suitable type of organization for mycological work dealing with planters' crops.

Mr. Anstead replied that a planters' mycologist was already appointed for South India, and that he was expected in September. He would have a laboratory of his own in one of the planting districts. At present he would be stationed for six months at head-quarters at Coimbatore and would tour all over the districts. He would then decide for himself where to have his central laboratory.

The Chairman remarked that mycologists worked under great disadvantages, if isolated, but the question of centralization of mycological work was one of great complexity. He personally favoured the idea of a central laboratory and library with branch laboratories for the study of local problems. Such branch laboratories would not require much equipment.

Mr. Anstead said that, in Coimbatore, planters' crops could not be grown, which would be a difficulty in the way of making it the central laboratory for work on these crops.

The main disease of tea was brown blight, *Colletotrichum Camelliæ* (*Glomerella cingulata*). They had done a good deal of work on its prevention. The disease could be controlled by spraying and manuring. At present spraying was out of the question because of the difficulty of getting sprayers. The planters were marking time, but as soon as sprayers were available this work would be taken in hand. Meanwhile the attacks were controlled by hand-picking diseased leaves; this was feasible because there was no difficulty in getting labour. Pest gangs were being organized on the same lines as similar gangs on rubber estates. They were chiefly employed in fighting root diseases and in picking brown-blighted leaves. They also followed the pruners and cut out any bark disease and applied washes for epiphytes.

The Chairman remarked that pest gangs were largely employed on the rubber plantations in the Federated Malay States. They consisted of perhaps 15 to 20 men. They looked after root diseases, bark diseases, and broken branches, and did much to improve the sanitation of estates. Against pink disease they were invaluable.

Mr. Anstead said that rubber diseases were a large problem. In South India they had to deal chiefly with pink disease and leaf-fall due to *Phytophthora Meadii*. Various experiments had been

carried out recently for the control of pink disease. Painting the stems and lower branches and forks of the young trees with Bordeaux mixture in the hot weather had given good results. Even treating alternate rows seemed to reduce the attack on the untreated trees. In one experiment the percentage of attack in the rows treated with Bordeaux was 1·98, while in the intervening untreated rows it was 3·22, and in the rest of the field 5·77. The trees should be done each year from the third to the seventh year of age, after which the damage was usually confined to the branches in the crown of the tree where the disease would be cut out with a minimum of harm. The treatment was preventive and therefore superior to painting with tar and oil after attack.

To control leaf-fall, Mr. McRae had recommended the removal of dead branches and stripping the trees of fruit. The method was undoubtedly sound, but there was the difficulty of labour to be contended with and pruning was not always practicable. The experiments carried out so far had been very promising. An interesting example was where a tree infected with red ants had been neglected in the middle of a treated block. When the disease appeared this tree stood out a mass of withering leaves while the rest of the block was green and suffered little. Further experiments were in progress ; but on account of the failure of the last monsoon few results were obtained this year.

Bark rots were systematically treated with an antiseptic, Izal for preference, on the tapping cut. It was proposed to disinfect tapping knives after tapping each tree. Nobody knew much about brown bast, a new disease which marked a crisis in the rubber industry. This disease, he thought, might possibly be due to defective cultural methods. Root diseases were now attracting attention. Brown root disease had been found in some places. A disease which might be identical with the Malayan wet rot also occurred. They were on the whole most troublesome in young clearings. Thinning which was now being done so extensively was likely to be a serious danger unless the stumps were removed.

A rubber mycologist was sanctioned and it was hoped to get one soon. This was in addition to the mycologist for planters' crops already appointed. The planters were taxing themselves by a cess which would be made over to the Government for the upkeep of the mycologist's staff and laboratory equipment. It was proposed to put him in a rubber district where he would have his laboratory, bungalow, and two assistants. For the library he would have to depend on Coimbatore where he would have to spend a definite period every year. It was proposed to have for purely mycological work two rubber experimental stations, as well as one for coffee and one for tea.

The Chairman inquired if it had occurred to the Planters' Association to run a large plantation as an experimental station, the profits to be utilized towards the expenses of scientific work. That was the practice in the Federated Malay States. The Government had recently taken up 2,000 acres for a coconut station and had also three large rubber stations. These were run by a manager who was not necessarily a pensionable Government servant. They yielded so large a profit that they nearly paid for the whole Agricultural Department.

Mr. Tunstall said that he had suggested something similar, but the Tea Association did not like the idea because they feared it might be looked upon as a business concern.

The Chairman said that this was of course a danger. The Government might look upon these stations more as money making concerns than as experimental stations. He did not wish to be considered as advocating the scheme but merely mentioned it. Such an experimental plantation would suffer unless the department was strong enough to control any attempts to secure a good balance sheet at the expense of experimental work. Rubber was exceptional in that the profits were so large that there was plenty of margin. He did not consider the method suitable for the Agricultural Department in India, but it might be useful for Planters' Associations. The danger of profit-making becoming the main feature in the scheme was a very real one, and, of course, research would be hampered by this attitude.

Mr. Anstead said that the germ of this idea existed in a rubber estate in South India, where a private estate of 800 acres was run in close consultation with Mr. McRae and himself. For the last six years the manager had always consulted them. A great many improvements suggested by them had been carried out and had profited the estate.

Mr. Tunstall said that in Assam many of the tea estates had chemical advisers who made out manurial programmes for the estates. They had joint deliberations regarding the chemical side of the tea industry.

Mr. Anstead said that the plantations in South India were not as big as in North India, and they could not afford a separate scientific staff. Very often a young assistant was got with an agricultural training and placed in charge of experiments, but he soon drifted into the work of an ordinary assistant, as his activities had to be spent in several directions.

Mr. McRae said that in the Nilgiris the coffee root disease was due to *Fomes australis*. The disease seemed to have commenced on

dead *Grevillea* stumps. It started four years after *Grevillea* was cut out, and it gradually got worse. It also attacked orange trees. It was being studied in culture. Inoculations on young coffee had failed but had succeeded on *Grevillea* and old coffee. In a plantation of 80 acres 2,000 trees were reported to have died. In order to see if the disease was transmitted from root to root, two years ago an area, where there was one diseased tree with 17 healthy around it, was ringed. Eight of these trees had died last year. This disease was also to be found in the Shevaroy Hills. A new tea root disease with a red mycelium on the outside of the root had been found; he had got the fungus in culture but as yet there was no spore formation.

Mr. Tunstall described some tea diseases in North-East India. He said that brown blight of tea in Assam was caused by *Glomerella cingulata*. He had got the perithecial stage in culture. He had observed in one case typical brown blight conidia produced outside the perithecium from spores within it. There was another species of *Glœosporium* found attacking the leaf. The already described perithecial and pycnidial stages of copper blight had been obtained in cultures, but he had got a third spore-form on the leaves; it was a smaller pycnidial form with small spores and superficial.

The Chairman remarked that the allied black rot of vines also had three similar stages.

Mr. Tunstall said that the copper blight disease was worst in the rains when the perithecial stage was produced. In the cold weather large sized pycnospores were formed. He had not found the disease on jungle plants.

The Chairman inquired if Mr. Tunstall thought copper blight had any connection with brown blight.

Mr. Tunstall said they were quite different.

Mr. Tunstall, continuing, said that leaf diseases did not live long in prunings, probably because sunlight was a potent agent in disinfecting them. Grey blight quickly died of its own accord. *Blister blight was liable to be carried by persons from an infected garden visiting one free from disease. An outbreak in Mangaldai was caused by a planter who visited Darjeeling and carried the disease back with him.

He then described a mysterious disease of tea in Darjeeling, which, the planters thought, was due to bad soil conditions. On investigation it proved to be a definite stem disease caused by *Nectria cinnabarina*. This disease was carried to the tea bushes from fallen fruit-stalks of *Pyrularia edulis* and *Alnus nepalensis*. The tea branches

died off slowly. Whole bushes looked apparently dead, but they revived if they were collar pruned in the cold weather. This disease had been cured quite easily by spraying with lime-sulphur solution. Another recently observed disease was the black rot, which was found in damp situations but was so far not common. It was caused by a *Hypochnus* allied to, but apparently differing, in some details, from the species which caused black rot in Ceylon. Clearing the jungle and removing excessive shade seemed to be all that was necessary for checking it.

He next referred to the root disease caused by *Rosellinia arcuata* and *Sphærostilbe repens*. Diseased trees were dug out and roots carefully removed. If the roots of the neighbouring bushes were infected they were also removed. When throwing back the earth in the pits it was passed through a wire net in order to keep back cut roots.

Mr. Anstead said that in South India the same method was followed.

Dr. Shaw said that apple trees in orchards at Kumaun were killed by *Rosellinia*, and chemical examination had shown that the soils were deficient in lime and that the lime-magnesia ratio was favourable to disease.

Mr. Tunstall said that Assam soils were also deficient in lime where *Rosellinia* occurred. He did not however think that the soil conditions had anything to do with *Rosellinia* on tea roots. "Dadap" was used for green-manuring. Its leaves formed a heavy mat, and *Rosellinia* first appeared on them and then attacked tea bushes.

Mr. McRae said that a root disease of apples apparently due to *Rosellinia* existed in the Nilgiris. A variety known as Riverdale Pippin was used as a stock and was immune to *Rosellinia*.

Mr. Anstead inquired if lime was used in Assam.

Mr. Tunstall replied that it depended on the soil. In the case of *Hymenochæte noxia* and *Sphærostilbe repens* lime was used.

Mr. Anstead said that he strongly favoured the application of lime, first because it accelerated the decay of organic matter, and secondly because it gave the young trees a chance of picking up.

Mr. Tunstall said that root diseases frequently followed the death of either *Grevillea* or "neem" trees. It was essential to remove stumps of these trees two feet below ground level. Tea bushes were practically sure to die if *Grevillea* were cut out. *Semecarpus Anacardium* (the marking ink tree) was specially bad for starting *Hymenochæte noxia*. A good deal of information was gradually being obtained as to the most dangerous trees in respect to these stump rots in Assam.

The Chairman then suggested that a further discussion of the diseases of rubber might be of advantage, but as the subject was of interest to only a few members he thought it might be postponed until after the formal meetings had terminated.

The meeting then proceeded to discuss—

SUBJECT V.—MYCOLOGICAL EDUCATION IN PROVINCIAL COLLEGES.

The Chairman said that it was not suggested that this meeting should lay down any curriculum for mycology in provincial colleges. An exchange of the actual experience of those engaged in teaching mycology in agricultural colleges was what was required. He invited Mr. McRae to give the meeting the benefit of his experience.

Mr. McRae said that in Coimbatore they had two courses, a 4-year course and a 2-year course. In the 2-year course, which aimed at giving a general education in agriculture, there were 6 mycological lectures in the first year and 15 in the second year; each lecture being followed by 2 hours' practical. There was no attempt to teach the students microscopic technique. They examined slides prepared prior to the lecture. In the 4-year course a period of 3 months was devoted to mycology, during which time 30 lectures were given, each followed by 2 hours' practical as before. This course included microscopic technique. The students made their own preparations and supplemented them from laboratory slides. The course aimed at giving students a knowledge of the common diseases and simple remedies, and how to collect and send in specimens. For illustrating the manner in which a fungus lived on its host plant, he preferred the use of models to diagrams, and the two models which he had brought with him were samples of what were used in the Coimbatore classes. They were made by local workmen at Coimbatore. The headings of the lectures given in the 2-year course were as follows :—

Year	Serial number of the lecture in the syllabus	Title of the lecture
1st . .	27, 28 and 29	What a fungus is, on what it lives, and what parasitic fungi do to host crops, relation to crops, fungus diseases.
	63	Fungi on germinating seed. Smuts, damping—off. Disinfection of seed.
	85 and 86	Life-history of a fungus.
2nd . .	126	Parasites and saprophytes, their methods of getting food, *mucor*, *Pythium*.

Year	Serial number of the lecture in the syllabus	Title of the lecture
2nd	127	Mycelium, hyphæ, suckers, rhizomorphs, sclerotia.
	128	The common forms of fruit body, mushroom, bracket fungus, rust.
	129	Spores, conidia, sporangiospores, resting spores, germination of spores. Infection of host plant.
	130	Dissemination of fungi.
	131 and 132	Effect of fungi on their host plants.
	133	Methods of control of fungus diseases.
	134	Sprayers.
	135	Preparation and application of fungicides.
	136	Diseases of cholam,* cumbu,† tenai.‡
	137	,, paddy, sugarcane.
	138	,, cotton, tobacco.
	139	,, palms and fruit trees.
	140	What to observe and how to record the progress of a disease. Selection and preparation of specimens for examination. Demonstration of the simple laboratory methods of examining a diseased plant. Plotting, pure culture.

The Chairman said that the meeting was extremely indebted to Mr. McRae for his interesting explanation and exhibits. The models were very excellent examples of their kind, and it would be a great advantage if they could be made and distributed to all colleges. Show cases such as were used in Pusa might also be useful.

Mr. Tunstall suggested that such show cases instead of being made of wood might be made from card board covered with celluloid.

Mr. Ajrekar said that, at Poona, the equipment was insufficient; they had nothing as good as Mr. McRae's models and relied rather on lantern lectures. He would ike to purchase models from Coimbatore. The lectures were divided up into—

(1) general morphology and physiology of fungi.
(2) parasitism.
(3) diseases of crops.

The Chairman inquired whether any officer engaged in mycological teaching ever thought of publishing his lectures in book form. There

* *Andropogon Sorghum*; † *Pennisetum typhoideum*; ‡ *Setaria italica*.

was at present no suitable text-book for the use of students. A small, handy and cheap book was required.

Mr. Robertson Brown expressed the hope that in thinking of mycological education the meeting would bear in mind the needs of the cultivator in the field and not only those of the student in the college. He would like to see suitable models and show cases at the Agricultural Department's farms where visitors would see some of the simpler and more important facts clearly demonstrated.

Mr. Ajrekar said that in Bombay they had mycological stalls at the various agricultural exhibitions throughout the Presidency.

Mr. Srivastava, in response to an inquiry from the Chairman, stated that the mycological course in Nagpur consisted of 10 lectures, each followed by 2 hours' practical, delivered in the last month of the session. The lectures dealt with specific common diseases and their remedies.

Mr. Venkata Rao stated that in Mysore they had an agricultural school attached to the Hebbal Experimental Farm. The lectures given were general and dealt with common diseases and fungicides. The object was to train men as observers to collect and send in material of diseased crops.

Mr. Hafiz Khan said that at the Forest College at Dehra Dun the mycological instruction consisted of a few lectures—there was no practical work.

The Chairman referred to the mycological courses given in agricultural colleges and some universities in the United States. The elementary courses seemed to be on the lines of those in India. In some of the more advanced of the American courses the students did an infection for themselves.

Mr. McRae remarked that at Coimbatore the students were shown any infections which were actually being done at the time.

Mr Ajrekar then briefly described the revision classes in field mycology which were held during the third year work at Poona.

Mr. McRae next described the mycological classes for " estate writers " at Coimbatore. The object of these classes was to train ' writers " from rubber estates to carry out plant pathological observations and plant sanitation on rubber estates. The course aimed at giving the men sufficient instruction to enable them to recognize the common diseases, and to carry out simple remedies. If necessary they would know how to collect material and send it in for examination. The classes consisted of 10 men, and it was absolutely essential that the men should know English. The first 10 days of the course were given to ordinary botanical instruction—

this was necessary as the men had no scientific training—and the remainder of the time was spent in studying diseases of rubber.

Mr. Anstead stated that at present the course is rather in an experimental stage but the men turned out, so far, have done well. They are placed in charge of " pest gangs " on the estates. He was greatly indebted to Mr. McRae for taking over this work of training " writers." With the appointment of a rubber mycologist the work would, of course, be done b y him.

Mr. Ajrekar said that in Poona they had one month classes in sugarcane culture in the vernacular, and classes in arboriculture in English.

Mr. Tunstall stated that any attempt to train men for work on tea gardens on the lines of the " writers class " at Coimbatore would be hampered by the necessity of conducting it in the vernacular. At present his energies were absorbed in teaching laboratory technique to his staff.

The Chairman commented on the neglect of mycological teaching in the universities.

Dr. Shaw referred to the unsuitable character of such mycological education as existed in Indian universities. Students taking examinations in botany of the standard of the M.Sc. degree were totally ignorant of the fungi of their own country, although they could answer complicated questions on European fungi and plant diseases. Their knowledge of such matters could only be derived from periodicals and text-books published in England, although better and more practical instruction could be obtained from examples and publications in their own country. A student taking an honours degree in botany ought to know the botanical literature and plants of his own country before any other, but some Indian universities appeared to resent any questions in their examinations set on these lines.

Captain Froilano de Mello favoured the meeting with his experience in Goa. He had had to organize a course in microbiology and tropical pathology. A standard mycological text-book suitable for use in all colleges, and not merely in agricultural colleges, was very desirable. It should contain complete instruction in laboratory methods. He trained his students so that they could themselves give instruction in what they had learned.

Mr. Tunstall agreed that a mycological text-book for Indian colleges was much required.

The Chairman then inquired whether the sense of the meeting was in favour of passing a formal resolution calling attention to the neglect of mycological teaching in Indian universities.

Mr. McRae deprecated the passing of any formal resolution.

Mr. Dastur considered that such a resolution should be put to the meeting.

The Chairman then proposed—

Resolution IX. **"That this meeting desires to call attention to the neglect of mycological science in Indian Universities, and wishes to emphasize the importance of the subject in India, and to urge on the Universities to give courses and found lectureships or chairs in the subject."**

Dr. Shaw seconded this.

The resolution was carried.

The meeting then proceeded to discuss—

Subject VI.—The application of genetics to the control of plant disease.

The Chairman said that he wished at this discussion to review the progress which had been made in the application of genetics to the control of plant disease, in order that the meeting might form some opinion as to how far this method was applicable to Indian conditions. At present there were only a few cases in which a deliberate and successful attempt had been made in Europe to breed a strain of a crop resistant to a particular disease, *e.g.*, wheat and yellow rust. The reason of this was that in countries in Europe where agriculture had long been practised in a scientific manner, generations of nurserymen, in their struggles to place better varieties on the market, had been carrying on the unconscious selection of resistant strains. Thus, for example, the resistant strains of the potato had been entirely produced by the commercial breeders and not by scientists. In France, Germany, Italy, and Britain this held good. In a new country, like the United States of America, nurserymen had not been working so long, and new crops were continually being introduced. Thus in the United States of America a large number of cases of the production of resistant strains had been successful. The resistant strain was sometimes the result of selection, sometimes of hybridization, perhaps more usually the former, in the earlier stages at least. Thus the selection of haphazard non-diseased cotton plants had given remarkably good results against cotton wilt. In the case of the bean anthracnose, varieties of bean resistant to anthracnose were obtained by selection; later on these were crossed with better quality, more prolific types. Resistant strains of cowpea to wilt and root knot were similarly obtained. A resistant watermelon was the result of hybridization with an inedible variety which had

been observed to be immune to wilt. Other examples were strains of cabbage and flax resistant to *Fusarium*. The rust-resistant wheats now being isolated are usually the result of hybridization, not selection.

Turning to India, the fact that our local crops had not been subject to improvement by generations of nurserymen, anxious to produce the most successful strain, indicated that a wide field awaited research in this direction. More rapid results from experiments in the production of resistant strains could be expected in India than elsewhere. The problems of producing resistant strains were essentially local problems, and must be solved separately in different countries. It did not follow that a variety resistant in one country would be resistant in another. Wheats which were more or less resistant to rust had been bred in Pusa, and an Australian wheat which seemed almost entirely immune had been introduced at Peshawar. Crops which readily cross-fertilize are difficult to deal with, and bearing this fact in mind, he would welcome suggestions from the meeting as to lines of future work in India.

Mr. Hector said that Biffen's resistant wheats had spread very extensively in the Fen districts in England. They were bred for standing power and rust resistance.

Dr. Shaw said that these two qualities went together in Federation wheat.

Mr. Anstead said that Biffen considered that these two qualities were linked together Mendelianly.

Mr. Ajrekar stated that cotton selection against wilt disease was being carried out at Dharwar. The selections were crosses from Kumta and Broach ; hybridization was done first and then the resulting races were selected. Broach was very susceptible and Kumta resistant.

The Chairman said that Buri cotton was absolutely immune to wilt.

Mr. Srivastava stated that Buri cotton was not a very good yielder. In the Central Provinces it was being crossed with Cawnpore-American. With regard to wheats, some Australian rust-resistant varieties were introduced in 1913 but proved too late in ripening for the Central Provinces. They were being crossed with earlier local varieties. The same was being done with an Egyptian wheat. In local wheats, one selection from Khapli crossed with Bansi seemed to be resistant to rust. Crosses were being done with Medah, Combac and Sunset with local cotton, and seemed to be resistant. Vishnu cotton, a *Neglectum* variety obtained by selec-

tion, had escaped wilt this year on Akola Farm where there was much wilt last year.

The Chairman pointed out that conditions of immunity were not often due to mechanical factors in the structure of the plant. Immunity was in some cases really hypersensitiveness. The yellow rust fungus could only live on living cells of the wheat plant, and if the host cell died as soon as it was penetrated the fungus was unable to carry on. Physiological causes were much more important in making a plant immune than physical, although in a few fruit trees the immunity of the fruit seemed to be conditioned by a thick skin.

Mr. Venkata Rao stated that little damage from disease had been observed in the *ragi* (*Eleusine coracana*) selections in Mysore, so that their resistance had not been tested.

Mr. Anstead said that a new coffee hybrid, called Jackson hybrid, a cross between *C. liberia* and *C. arabica*, was somewhat resistant to leaf disease.

The Chairman stated that he anticipated that a beginning in rubber genetics would soon be made.

Mr. Tunstall stated that experiments on budding and grafting tea plants were being carried out with a view to shortening the process of improvement by selection.

Mr. Robertson Brown gave his experience on the reciprocal influence of stock and scion in oranges at Peshawar. He stated that thick-skinned, less sweet peaches were most resistant to fruit rot. Certain varieties of peach were more resistant than others to leaf curl.

The Chairman asked if chillies could be bred with a view to isolating resistant strains.

Mr. Hector pointed out that chillies cross-fertilized.

Dr. Shaw asked if jute was cross-fertilized to any extent as possibly it might be necessary to breed varieties of jute immune to *Diplodia Corchori*.

Mr. Hector replied that jute did not cross-fertilize.

Mr. Srivastava pointed out that in the Central Provinces work was being done on potatoes by propagating from berries instead of from tubers, and some superior varieties had been obtained.

Mr. McRae said that in the Nilgiris imported varieties of apple died out with root disease (*Rosellinia*), but that grafted on a stock called Riverdale Pippin they were immune.

The Chairman suggested the possibility of isolating races of *jowar* resistant to smut. Dr. Burns had pointed out this some years ago,

and recent work in other countries had suggested that there were greater prospects of success than had been thought at the time. This might be useful for the Bombay Department to remember if they were taking up work on the improvement of this crop.

Mr. Ajrekar agreed and said that all grain smuts could be tested in this way.

Mr. McRae said that, as this was the last formal meeting of the Second Mycological Meeting, he would like to take the opportunity of expressing the gratitude which he, and he was sure all other members of the meeting, felt to Dr. Butler for the manner in which he had presided over their meetings, and for the deep personal interest which he had shown in all their difficulties. He would like to include also Dr. Shaw and the other members of the mycological staff at Pusa for the trouble they had taken to make the meeting a success.

Mr. Anstead said that he had very great pleasure in seconding this motion. The meeting had been most instructive throughout, and he was particularly indebted to Dr. Butler for a very great deal of valuable information on the mycological problems of rubber planting.

The motion was carried with applause.

Dr. Butler, in reply, said that he looked forward to these meetings as the most interesting periods of his work in India, and it was a source of great gratification to him to know that others regarded it in the same light. He would welcome suggestions from members as to any manner in which the meeting could be made more interesting. He suggested that interesting material might, perhaps, be sent in two or three months before the meeting and then produced and discussed at the meeting. He proposed to send out a circular 6 months before the next meeting asking for material and suggest ons. They might take the opportunity of the next meeting of the Board of Agriculture of discussing informally among themselves any matters relating to the future mycological meeting, and especially whether a meeting at any other mycological centre, such as Coimbatore, would be an interesting change from Pusa.

In the evening Mr. Kulkarni gave a lecture, illustrated by lantern slides, such as is delivered in the vernacular to cultivators in the Presidency of Bombay. The object of the lecture was to explain, as far as was possible within the language and vocabulary of the ryot, the simple facts relating to local fungal diseases of crops. Some discussion followed the lecture and the general opinion of the meeting was that such lectures should be made as simple and brief as possible.

FOURTH DAY.

The meeting assembled again at 10 a.m. on the 23rd February in the Mycological Laboratory for an examination of the different types of sprayers in Pusa and discussion on laboratory technique.

After the formal meetings had concluded, a special committee consisting of Dr. Butler, Mr. Anstead, Mr. McRae, Mr. Tunstall, Dr. Shaw and Mr. Dastur met in the Mycological Laboratory for a more detailed consideration of the diseases of rubber.

The meeting terminated on the morning of the 24th February.

List of Resolutions passed at the Second Meeting of Mycological Workers in India held at Pusa on the 20th February, 1919, and following days.

1. That the Second Meeting of Mycological Workers in India desires to express its gratitude for the generous offer of assistance in phytopathological matters which has been received from the War Emergency Board of American Plant Pathologists. This meeting welcomes the opportunity of co-operating in mycological work with the scientists of an allied nation, and will do everything in its power to reciprocate in the exchange of information for the general furtherance of the objects of the War Emergency Board.

2. That in view of the work already done with the present limited staff and equipment, and in view of the number of important diseases of crops awaiting investigation in Bombay, this meeting recommends the early expansion of the mycological section of the Bombay Department of Agriculture so as to secure an adequate staff and equipment. **Subject I.**

3. That this meeting, representing practically the whole of the mycological workers in India, welcomes the proposal to establish an Imperial Bureau of Mycology to serve as a centre for the accumulation and distribution of information on the diseases of plants in the British Empire. **Subject II.**

4. That this meeting is of opinion that an Imperial Bureau of Mycology would be of the greatest value to plant pathologists in India, if it is organized on somewhat similar lines to, but naturally independent of, the existing Imperial Bureau of Entomology, and has as its chief functions—

(i) the organization of a system for the prompt identification of all injurious fungi for Departments of Agriculture and other similar bodies :

(ii) the publication of a periodical for summarizing current literature on plant diseases, British and foreign :

(iii) the preparation of classified lists of references to past and current literature of plant diseases, and the establishment of a reference library open to consultation by plant pathologists :

(iv) the answering of inquiries from plant pathologists.

5. That the preparation and distribution of a classified index of past and current literature in plant disease should be one of the chief functions of the Imperial Bureau of Mycology.

6. That while not in favour of the Bureau engaging in research work on its own account in the diseases of plants in India, this meeting would welcome any facilities that would be given to research workers from India and the colonies to pursue their investigations when temporarily in England, and for this object urge that laboratory space and equipment be provided for such workers at the seat of the Bureau. Furthermore, this meeting hopes that the Bureau will endeavour to keep in touch with the research workers engaged in the study of plant disease in all its aspects, so as to be able to advise in the selection of experts required for the investigation of particular diseases of urgency which it may be beyond the capacity of any particular colony to provide from amongst its own staff.

7. That as the Bureau expands and gains in experience, this meeting does not doubt that other fields will be found of equal importance for its activities, and in particular wishes to emphasize the importance of the application of the science of genetics to the control of plant diseases, and to express the hope that the Bureau may be able to keep this matter prominently before those engaged in the study of plant breeding.

8. That a copy of the minutes on Subject II be forwarded to the Agricultural Adviser to the Government of India, in order that that officer might submit a summary to the Government of India.

Subject V.

9. That this meeting desires to call attention to the neglect of mycological science in Indian Universities, and wishes to emphasize the importance of the subject in India, and to urge on the Universities to give courses and found lectureships or chairs in the subject.

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